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PUBLIC DOCUMENT.

No. 11.

FIRST ANNUAL REPORT

OF THE



HARBOR AND LAND COMMISSIONERS,

FOR THE YEAR

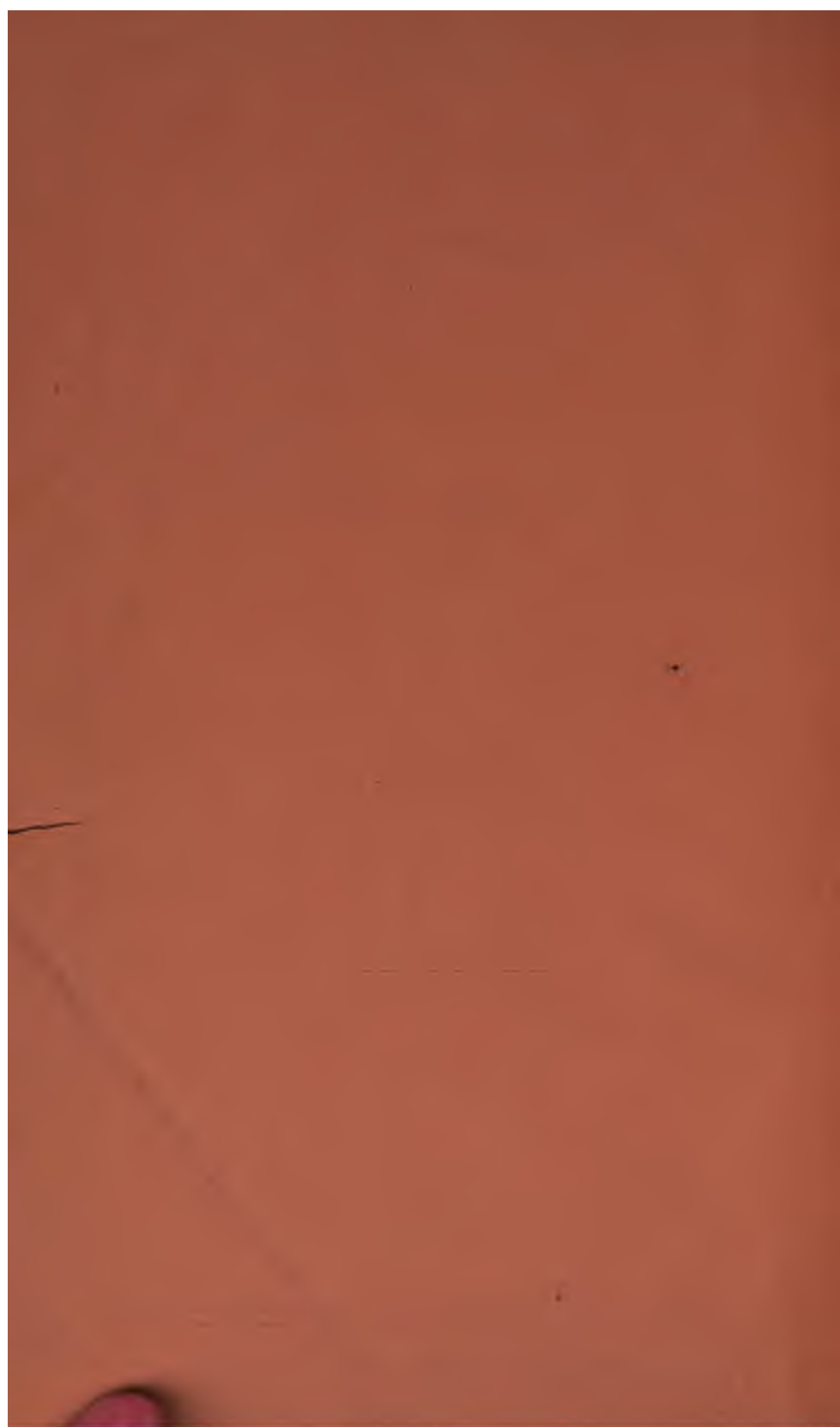
1879.

BOSTON:

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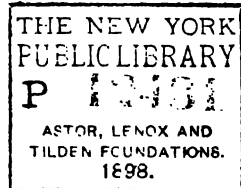


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HARBOR AND LAND COMMISSIONERS' REPORT.

To the Honorable the Senate and the House of Representatives of the Commonwealth of Massachusetts.

THE Board of Harbor and Land Commissioners, in accordance with the provisions of law, respectfully submit their Annual Report for the year 1879.

The Board were appointed under chap. 263 of the Acts of 1879, and entered upon their duties the first day of July, succeeding to the work heretofore in charge of the separate Boards of Harbor Commissioners and Land Commissioners.

This report presents the result of the work of the entire year so far as practicable.

SOUTHERLY BOSTON FLATS.

By this name is known the large area of flats belonging to the Commonwealth, beyond the riparian line of the north shore of South Boston, extending from Fort Point Channel to Castle Island, and including some 750 acres.

Prior to 1869 the southerly bound of the Commonwealth's property adjoining the property of the Boston Wharf Company had not been adjusted; but in that year it was definitely settled. The line to which filling could be extended had also been then determined. And in that year a sale of what is now known as the 25-acre piece was made to the Hartford and Erie Railroad for the sum of \$545,505, or fifty cents per foot. At the close of that year a further sale of about 50 acres, next easterly of the 25-acre piece, was also sold to the Boston and Albany Railroad at twenty cents per

foot. For the purchase by the Hartford and Erie Railroad, a note secured by mortgage was taken; and by agreement the Boston and Albany was to pay for its land on the first day of October, 1872, either in cash, or in its bonds bearing six per cent interest, payable semi-annually, and agreed, "unless, for good cause shown," to build a substantial sea-wall upon the northerly side of its purchase, and to complete the whole filling of the 50-acre lot on the first day of October, 1875.

In December, 1871, the Hartford and Erie Railroad having failed to comply with the conditions of its mortgage, and not having paid its note, the land sold to it in 1869 was purchased at a mortgagee's sale by the Treasurer in behalf of the Commonwealth.

In 1873 the Boston and Albany Railroad, having neither paid the money for its purchase, nor even commenced the work of filling and walling, alleging "good cause" therefor, a new contract was made with that corporation by the Commonwealth. By this contract the time for filling was extended to Oct. 1, 1876, at which date the purchase-money was to be paid, and the whole work completed; and no interest was to be charged from Oct. 1, 1872, to Oct. 1, 1876, in consideration of the stipulations and agreements contained in this supplementary contract, and in the four-part contract of the same date between the Boston and Albany Railroad, the Boston Wharf Company, the city of Boston, and the Commonwealth; and by these contracts the Commonwealth agreed to fill and wall the 35-acre piece, and to do certain other things. [The contracts of 1869 and 1873 may be found in House Doc. of 1878, No. 24.]

Prior to the formation of this Board, the Land Commissioners had demanded from the Boston and Albany Railroad the purchase-money due in October, 1876, and had collected in April, 1878, the sum of three hundred and thirty thousand dollars on account. After that date there had been much correspondence, which may be found in House Doc. 21 of 1878, and in the Second Report (1879) of the Land Commissioners; but, when this Board was organized, no settlement had been made.

The early attention of this Board was given to this subject: but as a proposition had been made by the New York and New England Railroad to purchase the 50-acre lot from

the Boston and Albany Railroad, and to assume some of, or all, the obligations of the Boston and Albany to the Commonwealth, and negotiations were pending between these parties, a settlement of the matter was delayed by request of the Boston and Albany Railroad; and it was not until late in September that active negotiations were commenced between the New York and New England Railroad and this Board. At first the proposition by that corporation was to purchase a portion of the 25-acre piece, to alter the plan for filling the 50-acre piece, to construct the Northern-avenue Bridge, and to extend the time of the lease. While this proposition was under consideration, another proposition was made by the New York and New England Railroad,—to settle all the claims of the State against the Boston and Albany Railroad, to purchase the 12-acre piece and the 25-acre piece, and to build the Northern-avenue Bridge for its own use, by a promise of the New York and New England Railroad to pay to the Commonwealth at some future and undetermined date the sum of five hundred thousand dollars, which should remain at two per cent interest for five years, at three per cent interest for the next five years, and at four per cent interest for the next five years, “and as much longer as the Commonwealth may choose to let the debt run;” no deed of the land to be given until the five hundred thousand dollars with accrued interest were fully paid: but a full release was to be given to the Boston and Albany Railroad.

As the claim of the Commonwealth against the Boston and Albany Railroad, exclusive of any claim for damages, and the cost of material already placed in the 12-acre lot at the low contract price of the Boston and Albany Railroad, would amount to about a hundred and fifty thousand dollars,—leaving for the 12-acre piece partially filled, and for the 25-acre piece filled and walled at a cost to the State of nearly a million of dollars, only three hundred and fifty thousand dollars, or about twenty-one and a half cents per foot,—the proposition was declined.

Subsequently it was proposed to have the price fixed by two gentlemen, both named by the corporation: but this proposition was also declined, because, if the price proposed to be paid was approximate to the estimate by the New

York and New England Railroad of the value of the land, it was clear to the Board that the time for sale had not arrived; and, besides, there was land contiguous to the State's land, held by private parties, which could be purchased by the corporation, if it so desired.

It was suggested, that, because the State owned some stock in the New York and New England Railroad, that corporation should be treated more liberally than other parties; but this was not assented to by the Commissioners, who failed to see why a round sum should be allowed, one-sixth of which, if the Commonwealth were at liberty at any time to sell its stock, and so avail of any benefits received by the corporation, would go to the State, while five-sixths would go to the other owners of the stock, provided the property of the corporation shall in the future exceed its bonded debt. If not, the whole gift would be to the bondholders.

But there is another and even a stronger reason why the Board could not consent to sell any of these lands, either to this railroad or to any other party, at a price below their real value; which is, that they are pledged as security to the holders of Massachusetts scrip.

When the State, already burdened by the use of her credit for the cost of the war and the Hoosac Tunnel, was compelled to borrow still more money for these purposes, she, by solemn enactment of law, pledged these lands to the payment of the war loan and the Hoosac Tunnel loan. These loans are not yet fully paid; and, until they shall be, this Board does not consider it any part of its duty as agents of the State in the first place to assent, and then to ask the consent of the Governor and Council, to any disposition of these lands, by which the proceeds of the pledged securities of the State shall be diminished, and the good faith of the State violated.

During the negotiations of this Board with the New York and New England Railroad, it became evident that it was hopeless to wait any longer for a settlement to be made between that corporation and the Boston and Albany Railroad; and that, in order to secure an earlier completion of the work upon the 50-acre lot, and its occupancy for business purposes, it was necessary for this Board to settle the outstanding account between the State and the Boston and Albany

Railroad without delay. To secure such result, a communication was at once sent to the Boston and Albany Railroad, asking for a prompt settlement of the account. Since then the various items thereof have been examined and discussed; and it is expected, that, in a very short time, the amount due from that corporation, except what is due for damages caused by its delay, will be paid into the treasury of the State. It is obvious that the whole amount of damage caused by this delay cannot be computed until the delay ceases.

With the approval of the Governor and Council, a contract (a copy of which is annexed) was made with Boynton Brothers for the filling of B Street; and a portion of the work has been done.

In addition to the flats already described, the State purchased of the riparian proprietors, under chap. 446 of 1869, all the flat between B and E Streets, except the interest of two parties (as fully described in the First Report of the Land Commissioners), for the sum of \$243,091.41.

The expenditures upon the South Boston Flats, as given in the Second Annual Report of the Land Commissioners (December, 1878), were \$1,004,237 28

In 1879 there have been expended,—

By Land Commissioners	22,637 02
Governor and Council (Clapp & Ballou)	81,202 73
Harbor and Land Commissioners	2,846 01
	\$1,110,923 04
The Boston and Albany has paid on account . .	\$330,000
The New York and New England Railroad	
has paid for rent	6,500
	336,500 00
Leaving	
	\$774,423 04

as the net cost to the State, exclusive of interest.

The 25-acre piece is the only land filled and now ready for occupancy. Had the Boston and Albany Railroad completed the filling of the 50-acre piece, as it agreed to do, the 25-acre piece would now have been accessible, of present value, and ready for sale, because a bridge would have already connected it with the city proper. Under the supposition that this bridge would speedily be built, there have been applications for the property from both purchasers and

lessees,—the purchasers at a price per foot above the average cost, and the lessees at rates much beyond the price now paid by the New York and New England Railroad. But, until some arrangement can be made to secure the Northern-avenue Bridge, the property is inaccessible, except by water, or by a circuitous route over land belonging to another party. The rental now paid by the New York and New England Railroad is ridiculously low for so valuable a piece of property, and the continuance of the present lease can be justified, if at all, only because the State cannot now guarantee to any purchaser or lessee free access to the property, except by water. Whenever deemed advisable, the present lease can be terminated by a twelve months' notice.

At present the New York and New England Railroad is the only railroad which connects with the property at South Boston, and is, apparently to the public, the only purchaser; but other parties with large capital have already notified this Board of their desire to make arrangements for the occupancy of these flats.

And here this Board would proceed to call your attention to the connection of these flats with existing railroads, were it not, that, by the action of the last legislature, that subject was referred to a special commission, consisting of the Board of Railroad Commissioners and this Board.

But, in considering the value of this property, it is well to remember that the present terminal facilities which can be used for shipping freight received from the West, owned or controlled by the Boston and Albany, the Fitchburg, and the Lowell Railroads, below bridges, and exclusive of South Boston, are less than 50 acres in all: while in Baltimore two railroads use over 200 acres; in Philadelphia the Pennsylvania Railroad controls two miles of water-front; and in Jersey City the Erie and Pennsylvania Railroads together occupy 250 acres, besides the large grounds near Amboy; and the New York Central has recently secured land enough in the city of New York to give it a water-front of over 3,000 feet. If Boston is to be a shipping port, and intends to secure its share of Western business, it is time to prepare these grounds for occupancy, and to provide by law for reaching them.

BACK BAY LANDS.

	FEET.
The whole quantity of land in the Back Bay, so called, belonging to the State in 1857, was	4,723,998
Prior to Dec. 1, 1879, there had been do-	
nated to scientific institutions	144,738
Transferred to Trinity Church	6,447
Transferred to city of Boston	163,555
Devoted to streets and passage-ways	2,037,068.6
Sold, as per statement annexed	2,084,931.6
Leaving unsold Dec. 1, 1879	287,257.8
	4,723,998
The gross proceeds of the land sold have been	\$1,307,722 17
The rights of the State in Parker Street have been sold for	2,200 00
Making the total gross receipts	\$1,309,922 17
The cost of filling, grading, &c. (see Land Commissioners' Second Report), prior to 1879, was	\$1,626,008 71
The cost of auction sales, &c., to July 1, 1879, as per sales-book, was	14,291 78
	1,640,300 49
Net proceeds to Dec. 1, 1879	\$2,669,621 68

From this it appears, that, while only 44.13 per cent of the whole quantity of land belonging to the State has been sold (the remainder, except 287,257.8 feet unsold, having been given away or used in streets, &c.), the Commonwealth has already received a net profit of 56.51 cents per square foot for every foot owned by it in 1857; while the 2,084,931.6 feet of land sold have averaged \$2.066 per square foot gross, and, after deducting all expenses of filling, 4,723,998 feet have yielded a net profit of \$2,669,621.68, or \$1.28 per square foot sold.

Annexed to this report will be found a plan of the Back Bay lands, showing the date and price at which every foot of land belonging to the Commonwealth has been sold.

During May last the Land Commissioners sold at auction 32,868 feet of land upon Commonwealth Avenue for \$109,883.68, and, at private sale, 2,863½ feet for \$7,158.75.

The prices at which these sales were made were considered high, and from that time a better feeling existed in regard to

the value of Back Bay lands, although prior to Oct. 20 there was no active demand for land ; but, within thirty days after, sales were made of —

33,739.5 feet on	.	.	.	.	Commonwealth Avenue.
31,192	"	.	.	.	Marlborough Street.
11,177.6	"	.	.	.	Beacon Street.
2,352	"	.	.	.	Newbury Street.

In all 78,461.1 feet, for \$242,270.75.

Upon these sales there were no charges of any kind, the Commissioners having made the sales without the intervention of brokers.

The land belonging to the Commonwealth, and still unsold, is all beyond Dartmouth Street, and is located as follows : —

					FEET.	
Marlborough Street, north side	.	.	.	.	22,377.6	
Marlborough Street, south side	.	.	.	.	25,345.6	
						47,723.2
Commonwealth Avenue, north side	.	.	.	.	9,810.6	
Commonwealth Avenue, south side	.	.	.	.	16,185	
						25,995.6
Newbury Street, north side	.	.	.	.	45,808	
Newbury Street, south side	.	.	.	.	46,928	
						92,736
Boylston Street, north side	.	.	.	.	46,928	
Boylston Street, south side	.	.	.	.	73,875	
						120,803
Total square feet	.	.	.	.	.	287,257.8

For the land upon Newbury and Boylston Streets, there is as yet no active demand ; but, whenever the extension of those streets to the new park shall be completed, a ready sale at good prices is expected.

For the land upon Commonwealth Avenue and Marlborough Street, an early sale is anticipated at improving prices.

BRIDGES OVER COLE'S RIVER AND LEE'S RIVER.

The Fall River, Warren, and Providence Railroad Company, under the provisions of chap. 241 of the Acts of 1879, submitted for the approval of this Board plans for the reconstruction of its bridges over Cole's River and Lee's River

without draws. Notice was given to the selectmen of Swansey and Somerset, and a public hearing was had on the 24th of July. The selectmen of both towns appeared in opposition to closing the draws, and a strong local feeling was shown in favor of retaining them in both bridges.

At the hearing, the counsel for the remonstrants claimed that the Act of 1879 was unconstitutional; that a State has no power to authorize a bridge without a draw across a navigable river constituted by United States legislation a part of one of its ports. It was urged, that, as the Act was not mandatory, but conferred discretionary power only, if the authorities showed that the approval of a bridge without a draw would not protect the petitioner in erecting such bridge, such approval should be refused. The very important bearing of the question thus presented upon all the duties of the Board, as well as the weight of the suggestion of counsel in relation to the exercise of discretionary power, led to a somewhat careful examination of the authorities. For convenient reference hereafter, it may be useful to state briefly the result of this examination.

The limitation of State authority is supposed to arise from the provision of the Constitution of the United States, which gives to Congress power "to regulate commerce with foreign nations, and among the several States, and with the Indian tribes." The final and authoritative interpretation of this provision must be sought in the decisions of the Supreme Court of the United States. Its meaning was considered by that Court in *Gibbons v. Ogden*, 9 Wheat., 1, decided in 1824, wherein it was held that a State law, giving to certain persons for a term of years exclusive right to navigate the waters of that State with boats moved by steam or fire, was inoperative against the laws of the United States regulating the coasting trade. In the opinion by Marshall, C.J., the Court says, "The power of Congress, then, comprehends navigation within the limits of every State in the Union, so far as that navigation may be in any manner connected with commerce with foreign nations, or among the several States, or with the Indian tribes." The Court, however, declined to decide whether the power conferred upon Congress was exclusive, or whether a concurrent power over the same subject remained with the

States, as in either case, if the State law was in conflict with that of Congress, it must yield, inasmuch as the Constitution by express provision declares that it and the laws made in pursuance thereof are the supreme law of the land. The supremacy of Congress in the regulation of foreign and interstate commerce has been confounded with the exclusive control of it; and, in several cases, *Gibbons v. Ogden* has been cited by the same Court as having established the law that the power of Congress over the subject was exclusive. In *Willson v. the Blackbird Creek Marsh Co.*, 2 Pet., 250, however, a State law authorizing a dam across a navigable creek was held valid; and the Court said the power of Congress to regulate commerce with foreign nations, and among the several States, had not been so exercised as to affect the question, though the plaintiffs were owners of a vessel regularly licensed and enrolled for the coasting trade. The question was more fully considered in *Gilman v. Philadelphia*, 3 Wall, 713, decided in 1865. The power of Congress to control navigable waters that are accessible to interstate commerce, to keep them open and free from obstruction interposed by the States or otherwise, was asserted in this case as unequivocally as in any previous case; but it was fully recognized that the States have concurrent power over the same waters, qualified only by the supreme control which Congress may exercise; and State legislation authorizing a bridge without a draw over the Schuylkill River was held valid. It was admitted that the bridge would obstruct important navigation, and that it and the river above it were within the port of Philadelphia; yet the Court not only thought it competent for the State to permit and regulate the building of such a bridge, but that the State was the appropriate power to exercise the control required. The Court use this language: "It must not be forgotten that bridges, which are connecting parts of turnpikes, streets, and railroads, are means of commercial transportation, as well as navigable waters, and that the commerce which passes over a bridge may be much greater than would ever be transported on the water it obstructs. It is for the municipal power to weigh the considerations which belong to the subject, and to decide which shall be preferred, and how far

either shall be made subservient to the other. The States have always exercised this power; and, from the nature and objects of the two systems of government, they must always continue to exercise it, subject, however, in all cases, to the paramount authority of Congress whenever the power of the States shall be asserted within the sphere of the commercial power which belongs to the nation." It is true the Court were not unanimous in this decision, and a very earnest dissenting opinion was given by one of the judges; but the question was again carefully considered in *Pound v. Turck*, 95 U. S., 459, decided in 1877, and the doctrine of *Gilman v. Philadelphia* was re-affirmed as the settled law.

In the case before the Board, the railroad passing over the bridges extends into Rhode Island, and the business over it is largely interstate commerce. There would seem to be no greater reason for apprehending that Congress would interfere in behalf of commerce passing under the bridges to require draws, than in behalf of that passing over them to prohibit draws.

The only ground, aside from the legal position taken, urged for requiring draws in the bridges to be rebuilt, was the possibility that greater use might hereafter be made of the rivers. As the Act of 1879 contains adequate provision for obtaining a draw in either or both of the bridges whenever the circumstances should justify or require it, the Board determined that until otherwise ordered neither of said bridges should have a draw, and approved plans accordingly.

HARBOR LINE.

In the last Annual Report the subject of the study of the harbor lines, with a view to such redetermination of them as might appear, upon examination, to be desirable, was submitted as a sequence to the elaborate surveys which had been made. Since the completion of the maps, the Board have made a careful study of all the results of the resurvey together with a full consideration of the former harbor line, not only in reference to the defective data for its identification, but of the nearly obsolete and disadvantageous nature and location of many parts of it, and are fully con-

firmed in the conclusion that a revised and redetermined line is necessary for the proper legal and physical supervision of the harbor.

In view of the various projects for the treatment of Charles-river Basin, and from the fact that harbor lines have recently been established in that portion of the river, the Board deem it inexpedient to present any restatement of the harbor line above West Boston Bridge. The provisional legislation relating to South Bay is also sufficient for the action of the Commonwealth in regard to it, and no restatement of the harbor line is needed above Dover-street Bridge. In view of the projects for the improvement of the flats and frontage at and beyond East Boston, the Board deem it best to await further developments before dealing with this side of the harbor, in order that their own action may harmonize with other improvements.

The harbor line presented at this time provides for the frontage of the city proper only, including the city side of Fort Point Channel and Charles River, between Dover-street and West Boston Bridges; and also for the opposite side of Charles River, from West Boston Bridge to the Navy Yard. The Board have substantially concurred in the scheme prepared, at their request, for this portion of the frontage by Professor Henry L. Whiting, in regard to which he says, —

“ Without entering into a discussion of the principles of compensation or the complicated physical condition of the harbor, it is important to state, that the new harbor line so closely follows the present configuration of the harbor outline, as formed by actual structures, most of which have been standing for so long a time, that the impressions due to their condition and position have already been effected; that no physical influences, caused by such slight deviations from existing outlines as occur, have been taken into account. The project has been based, mainly, upon the adjustment of water-spaces to symmetrical lines of frontage best adapted to navigation and occupation. Where the revised harbor line does deviate from the former line and from existing outlines, it is for the purpose of correcting irregularities, and improving the general alignment of the harbor frontage.

“ In order that the revised harbor line may clearly and in fact define the *actual limits of the harbor*, it has been so projected that it will in no case fall *within any existing structure*, except where it may cross the lines of bridges. In some cases it coincides with the outer faces of wharf structures as they now exist; and many of the initial points or points of deflection in it are coincident with the outer corners of present wharves;

and the line has been projected with a view to the extension of other wharf and sea-wall structures to it; and it is desirable, if such structures are so brought out, they should coincide as nearly as practicable with the harbor line, while in no case should they extend beyond it."

After due consideration, the Board deem it expedient to recommend but one harbor line; and, although the suggestions by Professor Whiting of two parallel lines to define the coping and foundation lines of frontage structures have features of advantage, they are in a measure technical; and one line with proper restrictions seems sufficient to practically define the harbor outlines, and accords with all the precedents of similar legislation. The line now presented corresponds with, and is intended to be, a *coping line*, or a line with which the coping line of structures may coincide, but shall in no case exceed.

Professor Whiting further says, —

"An important feature in the work is the accurate determination and permanent marking of the points in the harbor line. Experience has proved that reference to local objects, even of apparently stable character, is insecure; and this fact was one of the reasons and requirements for a resurvey of the wharf-lines of the upper harbor, and for basing it upon the costly and perfectly determined triangulation of the United States Coast Survey, — the main points in this triangulation being so securely marked as to preserve them from the probable contingencies of accident. It was also a feature in the scheme of the resurvey to connect each initial point or point of deflection in the harbor line with the points in the harbor triangulation; in fact, to make the points of deflection in the harbor line actual points of triangulation. A practical difficulty, however, arises in the execution of this plan, from the fact that many of the points of deflection in the harbor line will fall in *water*. It became necessary, therefore, to locate and determine a point on some actual structure which would be accessible for instrumental occupation, and where local markings could be made as near as practicable to such points of deflection in the harbor line as could not be marked, and to make these points of triangulation '*reference points*' from which the points of deflection in the harbor line could be determined by measured or computed distance and direction."

This work has been done, and a series of reference points selected and marked, and the references to the points in the harbor line effected. With the execution of the observations and computations connecting these points of reference with the harbor triangulation, the work will be complete. The geographical position of each reference point, and of each

point in the harbor line, will then be given in tables similar to those for the same class of data published in the last report of the Board.

The work of selecting and marking the reference points, and the observations and computations connecting them with the points in the harbor line, has been executed by Mr. William E. McClintock with a degree of precision which has given to these final minute determinations the same exact character as the accurate bases from which they are derived.

The only important deviation from the general trend and location of the former harbor line occurs on the Charlestown side of Charles River, between the northern terminus of the Boston and Lowell Railroad passenger bridge and the Sheares Wharf of the United States Navy Yard.

Along this portion of the harbor frontage, the former system of harbor lines, prescribing the boundaries of Miller's River and Prison Point Bay, is no longer required; and the filling up of these water-spaces, for which compensation has been made, gives to the remaining water-way, which was formerly the entrance to Miller's River, the character of a dock, and as such it has been considered, so far as projecting the harbor line across its entrance is concerned.

By chap. 277 of the Acts of 1879, the Hoosac Tunnel Dock and Elevator Company were authorized to take or purchase the wharves and docks between Tudor's Wharf and the Navy Yard, and, subject to the approval of this Board, to extend its wharves beyond the harbor line. Nothing but an extraordinary commercial need could have justified the powers conferred upon this company; and it would require no less exigency to justify this Board in approving the extension of structures at this point into the deepest water of the harbor front, and at the narrowest point of the entrance to Charles River. The Board have very carefully considered the objections to the extension desired; but they recognize that there would be small encouragement for perfecting and preserving the harbor if it could not be adapted to the necessities of modern methods of commerce. The apathy of corporations and business-men in regard to the required provision for railroad terminal grounds on the waterfront, and their want of faith in the growth of the export business, have seemed to this Board and its predecessors sur-

prising. If there is arising a recognition of the pressing character of this need in any quarter, and a disposition of any parties to prove their faith in the business by providing facilities from the expenditure of their own money, asking no gift or aid from the public treasury, it is important that the fullest freedom should be given to such enterprise consistent with the guarding of what is essential to the safety of the harbor. Weighing these considerations carefully, and consulting the best scientific authority to which it had access, the Board has reached the conclusion, that, for the important purpose to promote which the legislature thought proper to give the right of eminent domain, the desired extension may be permitted. If the extension is made for this purpose, it is desirable that the line should be continuous from Charles-river Bridge to the Navy Yard; and the line is revised accordingly. The revision of the line above Charles-river Bridge, in connection with that below, will enable the Fitchburg Railroad Company to improve their terminal facilities, in connection with the Elevator Company, without serious additional disadvantages to the physical functions of the harbor.

Before drawing the lines, as herein prescribed, the Board gave public notice to all parties interested, as required by statute; and on the 18th of December a public hearing was afforded thereon, at which there were no objections or dissenting criticism made. Whereupon the Board report the following harbor line for the consideration of the legislature, and recommend that it be established by statute:—

The points which are points of deflection, and designated by the letters A, B, C, A^a, B^a, C^a, &c, and the points of reference from the said points of deflection, designated A', A'', A''', B', B'', B''', A^{a'}, A^{a''}, A^{a'''}, &c., in the following description of the harbor line, are drawn upon the map showing the said harbor line, and are written in the book of recorded data relating thereto in corresponding letters at the points indicated.

Each point of reference, where it is not an existing object, is marked in the substance and on the surface of the ground or structure where the point is located by a copper tack driven through a hole in the centre of an iron plate; said iron plate being about six inches square, and having the

words "Harbor Line" cast in the surface of each plate. In all cases where the points of deflection in the harbor line fall upon actual structures, they are also marked by similar copper tacks and iron plates.

The bearing, from the points of deflection in the harbor line to any point of reference, is in each case the angle with a line parallel to the true meridian passing through the State House, measured from south around by west; the geographical position of the State House being latitude $42^{\circ} 21' 27''.62$, longitude $71^{\circ} 03' 30''.00$.

The distances are given in feet and decimals.

The harbor line on the frontage of the city proper begins at point A on the northerly side of Dover-street Bridge, at its junction with the face of the wharf, and is marked by a copper tack through an iron plate on the face of the capsill, and is referred to points A' and A''. A' is on the plank sidewalk on the southerly side of Dover-street Bridge, and is marked by a copper tack through an iron plate: the bearing from point A to A' is the same as the harbor line between the points A and B. Point A'' is at the south-easterly corner of a brick building at the north-easterly corner of Dover and Albany Streets: distance from points A to A'', 122.54 feet; bearing from point A to A'', $104^{\circ} 46' 23''$.

Thence the harbor line runs northerly to point B, which is at the northerly corner of Pope's upper wharf, and is referred to point B' on the capsill of Pope's lower wharf, and is marked by a copper tack through an iron plate: distance from B to B', 35.60 feet; bearing from B to B', $198^{\circ} 03' 19''$.

Thence the harbor line runs northerly to point C, which is at the southerly corner of Furber & Bailey's wharf, and is referred to point C' on the capsill of the same wharf, and is marked by a copper tack through an iron plate: distance from C to C', 38.00 feet; bearing from C to C', $290^{\circ} 00' 20''$.

Thence the harbor line runs northerly to point D, which is at the southerly corner of Gutterson's wharf, and is referred to point D' on the northerly corner of Hamm's wharf, and is marked by a copper tack through an iron plate on the capsill: distance from D to D', 48.78 feet; bearing from D to D', $39^{\circ} 32' 04''$.

Thence the harbor line runs northerly to point E, which is near the intersection of the southerly side of Broadway

Bridge and the face of the wharf, and is referred to point E' on the southerly corner of the Boston and Albany Railroad wharf under Broadway Bridge, and is marked by a copper tack through an iron plate on the diagonal corner-brace framed into the capsill of the wharf: distance from E to E', 36.92 feet; bearing from E to E', $236^{\circ} 26' 53''$.

Thence the harbor line runs northerly to point F, which is at the angle in the Boston and Albany Railroad wharf about 100 feet below Broadway Bridge, and is referred to point F' on the capsill of the same wharf, and is marked by a copper tack through an iron plate: distance from F to F', 0.45 feet; bearing from F to F', $181^{\circ} 14' 42''$.

Thence the harbor line runs northerly to point G, which is at the face of the Boston and Albany Railroad wharf, at its intersection with the harbor line between the points G and H; said point G being about $24\frac{1}{2}$ feet from the corner of the same wharf, and is referred to points G' and G''. Point G' is on the harbor line between the points G and H, where said last-named line crosses the Old Colony Railroad bridge, and is about 65 feet south-westerly from the corner of a freight-shed, and is marked by a copper tack through an iron plate: distance from G to G', 206.18 feet; bearing from G to G' is the same as the harbor line between the points G and H. Point G'' is on the capsill of the same wharf as point G, and is marked by a copper tack through an iron plate: distance from G to G'', 22.78 feet; bearing from G to G'', $226^{\circ} 54' 57''$.

Thence the harbor line runs northerly to point H, which is the point of commencement of a curve in the harbor line of 338 feet radius; the harbor lines between the points G and H and between the points I and K being tangent thereto. The radius of curve is 338 feet; the length of tangent is 109.29 feet; the arc passed through is $35^{\circ} 50' 16''$. Point H is referred to point H' on northerly side of Federal-street Bridge, where the harbor line between the points G and H crosses said Federal-street Bridge, and is marked by a copper tack through an iron plate on the face of the capsill; also by a copper tack in the outside corner of the sidewalk cap: distance from H to H', 186.02 feet; bearing from H to H', the same as the harbor line between the points G and H.

Thence the harbor line runs northerly on an arc of a circle of 338 feet radius to point I, which is the point of termination of the curve whose point of commencement is at point H. Said point I is near Austin Wellington's wharf, and is referred to point I' on the southerly side of Mount Washington Avenue Bridge, where the harbor line between the points I and K crosses said Mount Washington Avenue Bridge, and is marked by a copper tack through an iron plate: distance from I to I', 464.84 feet; the bearing from I to I' is the same as the harbor line between the points I and K.

Thence the harbor line runs northerly to point K, which is at the angle in the outer face of Otis's wharf, about 80 feet south-westerly from the Pioneer Floating Dry Dock, and is referred to points K' and K''. Point K' is on the capsill of Otis's wharf, and is marked by a copper bolt through an iron plate: distance from K to K', 0.58 feet; bearing from K to K', $146^{\circ} 55' 52''$. Point K'' is at the south-easterly brick corner of a brick building on the northerly side of the entrance to Arch Wharf: distance from K to K'', 160.34 feet; bearing from K to K'', $62^{\circ} 11' 47''$.

Thence the harbor line runs northerly to point L, which is at the southerly corner of Long Wharf, and is referred to points L', L'', and L'''. Point L' is also on the same southerly corner of the said Long Wharf, and is marked by a copper tack through an iron plate on the capsill: distance from L to L', 0.59 feet; bearing from L to L', $105^{\circ} 43' 35''$. Point L'' is at the south-easterly corner of a brick building at the outer end of the said Long Wharf: distance from L to L'', 218.23 feet; bearing from L to L'', $107^{\circ} 57' 48''$. Point L''' is at the south-westerly corner of the same building last named; bearing from L'' to L''', $78^{\circ} 10' 43''$.

Thence the harbor line runs northerly to point M, which is at the northerly corner of Long Wharf, and is referred to points L'' and L''' before described, and also to point M' on the northerly corner of the said Long Wharf: distance from M to L'', 259.92 feet; bearing from M to L'', $53^{\circ} 42' 05''$: distance from M to M', 1.09 feet; bearing from M to M', $52^{\circ} 02'$.

Thence the harbor line runs northerly to point N, which is on the northerly corner of Union Wharf, and is referred to

point N' on the same northerly corner of the said Union Wharf, and is marked by a copper tack through an iron plate on a three-inch-thick false cap, which is spiked to the capsill of the wharf: distance from N to N', 1.29 feet; bearing from N to N', $26^{\circ} 01' 05''$.

Thence the harbor line runs northerly to point O, which is at the southerly corner of Battery South Wharf, and is referred to point O' on the same southerly corner of the said Battery Wharf, and is marked by a copper tack through an iron plate on the front capsill: distance from O to O', 1.53 feet; bearing from O to O', $179^{\circ} 29'$.

Thence the harbor line runs northerly to point P, which is at the northerly corner of Battery South Wharf, and is referred to point P' on the planking at the same northerly corner of the said Battery South Wharf, and is marked by a copper tack through an iron plate: distance from P to P', 2.43 feet; bearing from P to P', $29^{\circ} 44' 14''$.

Thence the harbor line runs northerly to point Q, which is at the southerly corner of Constitution Wharf, and is referred to point Q' on the same southerly corner of the said Constitution Wharf, and is marked by a copper tack through an iron plate: distance from Q to Q', 5.14 feet; bearing from Q to Q', $130^{\circ} 15'$.

Thence the harbor line runs westerly to point R, which is at the northerly corner of Constitution Wharf, and is referred to point R' on the planking at the same northerly corner of the said Constitution Wharf, and is marked by a copper tack through an iron plate: distance from R to R', 2.15 feet; bearing from R to R', $72^{\circ} 37'$.

Thence the harbor line runs easterly to point S, which is near the easterly corner of Fisk's wharf, about in the line of the easterly side of the wharf produced, and is referred to point S' on the outer end of the said Fisk's wharf, near a derrick, and is marked by a copper tack through an iron plate: distance from S to S', 87.95 feet; bearing from S to S', $95^{\circ} 25' 02''$.

Thence the harbor line runs westerly to the point T, which is near the angle in the outer face of Bartlett's south wharf, and is referred to point T' on the same outer point of the said Bartlett's south wharf, and is marked by a copper tack through an iron plate. Point T is also referred to a

point in the triangulation of 1877-78, called "Gray's wharf," which is at the north-westerly corner of a brick building on the said Gray's wharf: distance from T to T', 10.24 feet; bearing from T to T', $67^{\circ} 12' 15''$: distance from Gray's wharf to T', 68.44 feet; bearing from Gray's wharf to T', $12^{\circ} 28' 44''$.

Thence the harbor line runs westerly to point U, which is at the westerly corner of Bartlett's north wharf, and is referred to point U', which is on the easterly corner of the said Bartlett's north wharf, and is marked by a copper tack through an iron plate on the planking of the wharf: distance from U to U', 108.10 feet; bearing from U to U', $268^{\circ} 55' 43''$.

Thence the harbor line runs westerly to point V, which is at the angle in the outer face of the wharf of the Boston Gas-Light Company, about 187 feet from the easterly line of the last-named company's land, and is referred to point V' on the sill of the easterly coal-shed, and is marked by a copper tack through an iron plate: distance from V to V', 34.82 feet; bearing from V to V', $337^{\circ} 00' 22''$.

Thence the harbor line runs westerly to point W, which is at the angle in the outer face of the wharf of the Boston Gas-Light Company, next westerly from the angle at the point V last described, and is referred to point W' on the sill used as a guard on the west side of a passage-way between two coal-sheds on the said Gas-Light Company's wharf, and is marked by a copper tack through an iron plate: distance from W to W', 45.51 feet; bearing from W to W', $294^{\circ} 10' 23''$.

Thence the harbor line runs westerly to point X, which is at the westerly side of Charles-river Bridge at its intersection with the wharf-line, and is marked by a copper tack through an iron plate on the capsill outside of the sidewalk.

Thence the harbor line runs westerly to point Y, which is at the easterly side of Warren Bridge, about 17 feet north-erly from the outer face of Lovejoy's wharf, and is marked by a copper tack through an iron plate on the capsill outside of the sidewalk.

Thence the harbor line runs westerly to point Z, which is at the easterly side of the Boston and Maine Railroad bridge, where it intersects the face of the wharf at the head of the dock, and is marked by a copper tack through an iron plate.

Thence the harbor line runs westerly to point A^a, which is at the easterly side of the Eastern Railroad bridge, about 138 feet northerly from the head of the dock, and is marked by a copper tack through an iron plate, and is also referred to point A^{a'} at the north-easterly corner of the Boston and Lowell passenger station, at the outer corner of the stone plinth of the buttress: distance from A^a to A^{a'}, 138.03 feet; bearing from A^a to A^{a'}, 33° 43' 08". A^a is also referred to A^{a''}, which is at the westerly side of the Boston and Lowell Railroad passenger bridge at the intersection with the northerly face of the said Boston and Lowell freight bridge, and is marked by a copper tack through an iron plate on the capsill; said point A^{a''} being in the alignment of the harbor line between the points A^a and B^a.

Thence the harbor line runs westerly to point B^a, which is at the northerly side of the Boston and Lowell freight bridge, where it begins to curve, and is marked by a copper tack, and is also referred to point B^{a'}, which is on the same northerly side of the said Boston and Lowell freight bridge, and in the alignment of the harbor line between the points A^a and B^a produced, and is marked by a copper tack through an iron plate on the capsill: distance from B^a to B^{a'}, 36.18 feet; bearing from B^a to B^{a'}, the same as line between points A^a and B^a.

Thence the harbor line runs westerly to point C^a, which is at the northerly side of Craigie's Bridge, about 16 feet south-easterly from the old draw-pier, and is marked by a copper tack through an iron plate, and is also referred to point C^{a'}, which is at the easterly corner of the stone step to a brick building at the intersection of the easterly side of Charles Street and the southerly side of Leverett Street: distance from C^a to C^{a'}, 221.52 feet; bearing from C^a to C^{a'}, 320° 28' 19".

Thence the harbor line runs southerly to point D^a, which is at the northerly corner of the wharf between Poplar and Allen Streets, and is referred to points D^{a'} and D^{a''}. Point D^{a'} is at the southerly side of the scale-frame at the entrance from Charles Street to the Boston Gas-Light Company's wharf, and is marked by a copper tack through an iron plate: distance from D^a to D^{a'}, 248.32 feet; bearing from D^a to D^{a'}, 259° 09' 31". Point D^{a''} is at the corner of a brick building

at the angle in the easterly side of Charles Street, about 122 feet northerly from the northerly side of Poplar Street: distance from D^a to $D^{a''}$, 339.5; bearing from D^a to $D^{a''}$, $257^\circ 54' 35''$.

Thence the harbor line runs southerly to point E^a , which is at the northerly side of West Boston Bridge at its intersection with the sea-wall, and is marked by a copper tack through an iron plate on the cap outside of the brick sidewalk, and is also referred to points E^a' and $E^{a''}$. Point E^a' is at the north-easterly corner of the brick building on the south-westerly corner of Charles and Cambridge Streets: distance from E^a to E^a' , 136.11 feet; bearing from E^a to E^a' , $297^\circ 08' 38''$. Point $E^{a''}$ is at the south-westerly corner of the jail-yard fence about 80 feet northerly from the north-westerly corner of a brick building on the north-easterly corner of Charles and Cambridge Streets: distance from E^a to $E^{a''}$, 188.52 feet; bearing from E^a to $E^{a''}$, $253^\circ 23' 22''$.

The harbor line on the frontage of Cambridge and Charlestown begins at point A, at the northerly side of West Boston Bridge at its intersection with the face of the wharf, and is marked by a copper tack through an iron plate on the cap outside of the brick sidewalk.

Thence the harbor line runs north-easterly to point B, which is on the southerly side of Craigie's Bridge at its intersection with the face of the wharf, and is marked by a copper tack through an iron plate on the cap outside of the sidewalk, and is referred to point B' , which is at the south-easterly corner of the Boston and Lowell machine-shop: distance from B to B' , 73.39 feet; bearing from B to B' , $224^\circ 46' 19''$.

Thence the harbor line runs north-easterly to point C, at the southerly side of the Boston and Lowell Railroad passenger bridge at its intersection with the face of the wharf, and is marked on the capsill of the bridge by a copper tack through an iron plate.

Thence the harbor line runs easterly to point D, which is at the westerly side of Warren Bridge, about 100 feet southerly from the outer face of the wharf on the same easterly side of the said Warren Bridge, and is marked by a copper tack through an iron plate.

Thence the harbor line runs easterly to point E, which is at the easterly side of Charles-river Bridge, about 80 feet

southerly from the outer face of Tudor's wharf on the same easterly side of the said Warren Bridge, and is marked by a copper tack through an iron plate.

Thence the harbor line runs north-easterly to point F, which is about 80 feet south-easterly from the south-westerly corner of Hittenger's wharf, and nearly in the alignment of the westerly side of said Hittenger's wharf produced, and is referred to point E: distance from point F to point E, 379.00 feet; bearing from point F to point E is the same as the harbor line between said points E and F.

Thence the harbor line runs north-easterly to point G, which is at the south-westerly corner of the Navy Yard Shear's Wharf, and is referred to point G', which is near the same south-westerly corner of the said Navy Yard Shear's Wharf, and is marked by a copper tack through an iron plate: distance from G to G', 1.40 feet; bearing from G to G', $150^{\circ} 35' 00''$.

OFFICE AND FIELD WORK.

The routine work connected with the harbor duties of the Board, and the number of licenses granted, have been beyond the general average of former years. About one-quarter of the whole number of structures authorized to be built have been in Boston Harbor and vicinity: the remaining structures licensed have been distributed among the other harbors of the Commonwealth. This result of the yearly business of the Board shows an encouraging demand for harbor occupation, and the increase of facilities in them. The engineers of the Board have been fully engaged in field examinations, surveys, and office work.

The following statistics show the particulars of the work:—

Plans approved by the Board of Harbor Commissioners and the Board of Harbor and Land Commissioners, during the Year 1879, for the Erection of Structures in or over the Tide-Water, and Licenses granted for such Structures.

Nos.

451. Frank R. Kimball, for leave to construct a stone pier in front of his upland on Marblehead Neck. Approved Jan. 8, 1879.
452. John E. Wennerberg, for leave to construct a pile-wharf in Gloucester Harbor. Approved Jan. 8, 1879.
453. Alfred P. Norwood, for leave to construct a pile-wharf in Smith's Cove, East Gloucester. Approved Jan. 29, 1879.
454. John F. Wonson & Co., for leave to construct a pile-wharf in Smith's Cove, East Gloucester. Approved Jan. 29, 1879.
455. Daniel Gill, for leave to construct a pile-wharf in Smith's Cove, East Gloucester. Approved Jan. 29, 1879.
456. Sidney W. Oakes and Elisha M. Oakes, for leave to construct a pile-wharf in Smith's Cove. Approved Jan. 29, 1879.
457. Pigeon Hill Granite Company, for leave to build a breakwater and wharf in Rockport Harbor. Approved Feb. 5, 1879.
458. City of Boston, for leave to rebuild the draw-pier in Essex Street, or Cottage Farm Bridge, crossing Charles River. Approved Feb. 19, 1879.
459. Boston and Lowell Railroad Corporation, for leave to construct additions to its freight-bridge on the Boston side between its bridge and Craigie's Bridge. Approved March 12, 1879.
460. City of Boston, for leave to rebuild and enlarge the steamboat-wharf on Deer Island, Boston Harbor. Approved March 19, 1879.
461. Selectmen of the town of Falmouth, for leave to extend the bridge across the channel leading from Wood's Holl, Great Harbor, into the Mill Pond. Approved March 19, 1879.
462. Onset Bay Grove Association, for leave to construct a bridge over Swift's River in the town of Wareham. Approved March 19, 1879.
463. Jane A. Nelson, for leave to construct a wharf on Rocky Neck, Gloucester Harbor, partly solid and partly on piles. Approved March 19, 1879.
464. Old Colony Railroad Company, for leave to widen Derrick Wharf on Taunton Great River, city of Fall River. Approved March 26, 1879.
465. William E. Ansell, for leave to construct a pile-wharf on Rocky Neck, Gloucester Harbor. Approved April 2, 1879.
466. Putnam Nail Company, for leave to construct a pile-wharf in front of its works on Neponset River. Approved April 2, 1879.
467. Butchers' Slaughtering and Melting Association, for leave to fill solid a portion of its wharf on Charles River. Approved April 9, 1879.
468. Massasoit Steam Mill, for leave to extend its wharf on Taunton Great River, city of Fall River. Approved April 9, 1879.

Nos.

469. County Commissioners of Plymouth County, for leave to construct a pile-bridge across Green Harbor River in the town of Marshfield. Approved April 12, 1879.
470. Selectmen of Medford, for leave to build a stone bridge across Mystic River in place of Craddock Bridge. Approved April 30, 1879.
471. City of Taunton, for leave to rebuild its bridge across Taunton River at Weir Village. Approved April 30, 1879.
472. City of Cambridge, for leave to construct a ballast-wall on Charles River on the south side of Main Street, Cambridge. Approved May 7, 1879.
473. Jeffries Club, for leave to drive piles to keep its float-stage in position at Jeffries Point, East Boston. Approved May 14, 1879.
474. Samuel Downer, for leave to widen his southerly wharf at Downer Landing in the town of Hingham. Approved July 10, 1879.
475. William Johnston, for leave to build a wharf at the foot of Sixth Street, South Boston Point. Approved May 28, 1879.
476. Boston, Winthrop, and Point Shirley Railroad Company, for leave to construct its road around Winthrop Head to Point Shirley. Approved May 28, 1879.
477. Joseph K. Baker, for leave to widen his wharf on Nantucket Sound in the town of Dennis. Approved June 4, 1879.
478. Lewis C. Swift, for leave to construct a stone pier at Wood's Holl, Great Harbor. Approved June 11, 1879.
479. Selectmen of Westport, for leave to construct a solid wharf on the south side of Hicks's Bridge, across Westport River. Approved June 11, 1879.
480. Ignatius A. Kelly, for leave to drive piles to keep a float-stage in position at north side of Jeffries Point, East Boston. Approved June 18, 1879.
481. T. Bullen & Son, for leave to extend their wharf on Merrimac River, city of Haverhill. Approved June 18, 1879.
482. City of Boston, for leave to construct a sea-wall across a part of Roxbury Canal. Approved June 25, 1879.
483. J. H. Brown, for leave to extend his wharf in Marblehead Harbor. Approved June 25, 1879.
484. Latimer S. and F. W. Seaver, for leave to construct a pile-wharf on Plymouth Long Beach. Approved June 28, 1879.
485. Staples and Phillips, for leave to extend their wharf on Taunton River at Weir Village, city of Taunton. Approved July 17, 1878.
486. City of Boston, for leave to construct embankments, sea-walls, wharves, and other structures in connection with the system of improved sewerage at Old Harbor Point, Dorchester Bay. Approved July 28, 1879.
487. Proprietors of Boston Pier, or Long Wharf, for leave to widen its present wharf on the southerly side. Approved Aug. 7, 1879.

Nos.

488. Fall River, Warren, and Providence Railroad Company, for leave to reconstruct its bridges over Lee's and Cole's River, without draws, in the towns of Somerset and Swanzey. Approved Aug. 7, 1879.
489. J. H. White, for leave to build a sea-wall in front of his premises bordering on Marblehead Harbor. Approved Aug. 21, 1879.
490. Latimer S. Seaver, for leave to build a wharf on the south-westerly side of Captain's Hill, Duxbury. Approved Aug. 28, 1879.
491. Henry Breed, for leave to fill solid a portion of his pile-wharf in Lynn Harbor. Approved Aug. 28, 1879.
492. Maverick Oil Company, for leave to extend its wharf in Chelsea Creek, East Boston. Approved Aug. 28, 1879.
493. City of Boston, for leave to rebuild and widen part of Western-avenue Bridge across Charles River. Approved Sept. 11, 1879.
494. Nathaniel Webster, for leave to extend two wharves on piles to the harbor line in Gloucester Harbor. Approved Sept. 18, 1879.
495. City of Boston, for leave to construct embankments, sea-walls, and other structures, in connection with the system of improved sewerage between Old Harbor Point and Squantum, and between Squantum and Moon Island, Boston Harbor. Approved Sept. 22, 1879.
496. The same.
497. Joseph E. Stearns, for leave to construct a pile boat-pier at Monument Beach, town of Sandwich. Approved Sept. 25, 1879.
498. Amos A. Story, for leave to fill solid a portion of his wharf on Smith's Cove, East Gloucester. Approved Sept. 25, 1879.
499. Heirs of the estate of William Collins, for leave to extend their wharf in Harbor Cove, Gloucester Harbor. Approved Sept. 25, 1879.
500. Central Wharf and Wet Dock Corporation, for leave to make an addition to its present wharf on the south side. Approved Oct. 2, 1879.
501. Fred H. Seavey and others, for leave to construct a wharf near the foot of Charles Street in the town of Winthrop. Approved Oct. 9, 1879.
502. Pacific Guano Company, for leave to build a sea-wall, and fill the area enclosed, at Wood's Holl, Great Harbor. Approved Oct. 9, 1879.
503. Eben B. Phillips and others, for leave to build a plank pier or walk on Whale Beach in Swampscott. Approved Oct. 16, 1879.
504. Boston, Revere Beach, and Lynn Railroad Company, for leave to build a wharf and ferry-slip between Rowe's and Foster's wharves. Approved Oct. 23, 1879.
505. Henry E. Bradlee, petition for leave to rebuild and extend his wharf in Chelsea Creek, Chelsea side. Approved Oct. 23, 1879.
506. Michael Hurley, for leave to fill land-flats on Beach Street, and enclose the same by a wall, Lynn Harbor. Approved Nov. 13, 1879.

Nos.

508. Boston, Revere Beach, and Lynn Railroad Company, for leave to construct a wharf and ferry-slip in front of its property at East Boston. Approved Nov. 14, 1879.
509. Joseph W. Clarke, for leave to fill a strip of flats lying between the New York and New England Railroad Company's land and B Street, South Boston. Approved Nov. 20, 1879.
510. Steamboat Wharf Company of Chatham, for leave to extend its wharf at Stage Harbor, Chatham. Approved Dec. 11, 1879.
511. The Chatham and Harwich Marine Railway, for leave to construct a marine railway at Stage Harbor, Chatham. Approved Dec. 11, 1879.

FUND FOR THE MAINTENANCE OF THE WORK OF THE BOARD.

In the re-organization of the work of this Board which was made by the last legislature, it was desired by the committee having it in charge that some plan should be matured by which the Board and its work could be maintained independent of taxation. The present Board has given the subject some study, in the hope of presenting a plan by which this could be accomplished. Sufficient revenue for the maintenance of the work could not be obtained from fees imposed upon the licenses granted, without making such fees burdensome; but some revenue might equitably be derived from this source. A uniform fee for each license granted would not be practicable, unless it were made so small that the revenue derived would be unimportant. Many licenses granted are for small extensions of existing structures, or for structures in localities where their value is small; and a considerable fee would often be prohibitive of desirable improvements. If it should be deemed expedient to establish fees for licenses, the Board would recommend that discretion be given as to the amount to be charged, a minimum and maximum being fixed by statute.

Prior to the consolidation of the Land Commission with the agents for South Boston Flats in 1877, the appropriations for the maintenance of the Land Commission were made from the moiety of the proceeds of sales applicable to improvements. If the work of the present Board embraced nothing but the development and sale of Back Bay land, there would be no question but that this practice ought to be resumed. As the whole work of the Board is, in fact, the

care of the public interest in tide-water, and in the lands under or reclaimed from it, there would be manifest propriety in making provision from the profits of the Commonwealth's first encroachment upon the water, for the permanent care of that which remains. It is worthy of consideration whether from the proceeds of Back Bay lands not yet appropriated elsewhere, or from those hereafter received, something should not be reserved toward a fund for the permanent maintenance of the work in question.

The project of the reclamation of flats at South Boston grew out of a study of the needs of the harbor, and has been prosecuted with recognition of those needs. As the project has developed, the legislature has determined, that, without in any way permitting the harbor to suffer therefrom, the enterprise shall be conducted in future, as was the Back Bay reclamation, for the benefit of the treasury of the Commonwealth. Provision for the expense of prosecuting the work and guarding the harbor, by a reservation from the proceeds of the reclamation, would be very proper.

By chap. 284 of the Acts of 1874, it is provided, that, when wharves or other structures in tide-water are extended under license below the line of riparian ownership, the party licensed shall pay into the treasury, before the work is begun, such compensation as shall be determined by the Governor and Council to be just and equitable. Under this provision \$42,588.38 have been received for such occupancy of tide-lands since the passage of the Act. This legislation grew out of the work of the Board; and the money thus secured is directly due to the supervision it exercises, and could with great propriety be applied to the creation of the fund desired.

As the net receipts from the three sources named are now carried to the same sinking fund, the practical result would be the same from whichever the reservation were made.

From one or all the sources above indicated, a fund could be established, derived entirely from moneys received through the work of the Board independent of taxation, from which the appropriations for its maintenance could be made. It is not desirable that the fund should be received or controlled by the Board; but should be held by the Treasurer, as other funds of the Commonwealth, applicable only to the purpose

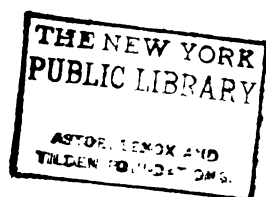
named, as the legislature should determine by appropriation from year to year. The receipts secured should be in excess of appropriations, sufficient to secure, before the probable exhaustion of the sources from which they are to be derived, a fund adequate to yield an annual income large enough to maintain the work. It can scarcely be doubted that each new service which government assumes should be made self-supporting, independent of taxation, so far as is practicable; and, while desirous of avoiding crude experiments or hastily conceived plans, we are satisfied that a plan somewhat like that we have outlined is feasible.

The work of the General Government in the harbors of the Commonwealth during the year will be found in statements kindly furnished the Board by the officers in charge, which are printed in the Appendix. The Board would acknowledge obligations to Gens. Thom and Warren, U.S.A., for courtesies received.

ALBERT MASON.
WILLARD P. PHILLIPS.
FRANCIS A. NYE.

Boston, Jan. 1, 1880.





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APPENDIX.

APPENDIX.

[A.]

THIS indenture, made this sixth day of September in the year eighteen hundred and seventy-nine by and between the Commonwealth of Massachusetts, acting by its Board of Harbor and Land Commissioners, subject to the approval of the Governor and Council, party of the first part, and Jesse Boynton of Providence in the State of Rhode Island, and Lyman Boynton of Boston in the Commonwealth of Massachusetts, copartners under the firm name of Boynton Brothers, parties of the second part, witnesseth that the said parties of the second part hereby covenant and agree with said party of the first part to fill B Street on the South Boston Flats, from Eastern Avenue to First Street, to grade thirteen, with material dredged from the harbor, and to do said filling in accordance with the lines, grades, and instructions which shall be given by the engineer of the Harbor and Land Commissioners, and to furnish all necessary aid and materials for giving said lines and grades.

Said filling within the area of B Street shall be protected on the sides by extending the same at the same grade six feet beyond the location, and thence sloping to the existing grade of the flats by a slope of eight to one on the easterly side, and four to one on the westerly side, except that the party of the first part may, at its election, provide other means of retaining the filling on either side or on any portion of the same, in which case the parties of the second part will not be required to protect the filling at the point where such other provision is made. The material for said filling shall be dredged from the harbor at such places as shall be assigned by the engineer of the Harbor and Land Commissioners, and by uniform excavation to the depth of twenty-three feet at mean low water ; and both the dredging and filling shall be executed to the satisfaction of the said engineer. Said parties of the second part covenant and agree to commence the execution of said work within thirty days from date hereof, and to prosecute the same with all reasonable despatch, and to complete the same on or before the first day of July next.

Said party of the first part hereby covenants and agrees with said parties of the second part to pay them for said filling at the rate of thirty-three and three-quarters cents per cubic yard measured in the work when completed. Monthly estimates of the work executed will be

made, and eighty per cent of the contract price paid thereon, the remaining twenty per cent to be retained till the completion and final measurement of the work.

It is expressly agreed that no material outside of the limits of the slopes herein provided shall be paid for; and the plan hereto annexed and signed by said Harbor and Land Commissioners and by said parties of the second part shall form the basis of measurement of the work when completed, and be binding upon both parties as the true representation of the existing grade at the commencement of the work.

The party of the first part reserves the right to construct one or more sluice-ways across said street, for the passage of the tide to and from the space west of the same.

It is expressly agreed, that, in the event of the failure of said parties of the second part to complete the said work on or before the first day of July next, the said parties of the second part shall pay to said party of the first part fifty dollars for each and every day beyond said first day of July, until the completion of said work.

In testimony whereof the said Commonwealth has caused its corporate seal to be affixed hereto, and these presents to be signed and delivered in its name and behalf, by its Board of Harbor and Land Commissioners, and the same to be approved by its Governor and Council; and the said Jesse Boynton and Lyman Boynton have hereunto set their hands and seals.

COMMONWEALTH OF MASSACHUSETTS,

[SEAL OF THE
COMMONWEALTH.]

By ALBERT MASON, }
W. P. PHILLIPS, } *Harbor and Land*
FRANCIS A. NYE, } *Commissioners.*

JESSE BOYNTON. [SEAL.]

LYMAN BOYNTON. [SEAL.]

Sales of Back Bay Lands belonging to the Commonwealth from 1857 to 1879 inclusive.

YEAR.	Quantity sold. Square Feet.	Amount.	Average Price per Square Foot.
1857	66,752	\$70,000 00	\$1.048
1858	316,455.5	406,280 53	1.283
1859	6,972	17,430 00	2.500
1860	340,653.5	581,263 71	1.706
1862	40,328	74,351 25	1.843
1863	419,209	871,586 30	2.079 ✓
1864	45,797	109,477 65	2.390
1865	59,145	165,925 47	2.805
1866	76,948	136,393 22	1.772
1867	8,848	12,828 48	1.449
1868	42,448	80,164 00	1.888
1869	193,984	384,855 52	1.982
1870	74,776	208,920 20	2.793
1871	172,297	485,093 30	2.817
1872	83,166	284,759 36	3.423
1873	22,900	59,080 00	2.573
1879	114,190.6	359,313 18	3.146
Total	2,084,929.6	\$4,307,722 17	\$2.066

[B.]

REPORT ON REVISION OF HARBOR LINE.

By HENRY L. WHITING.

To the Honorable Board of Harbor and Land Commissioners of the Commonwealth of Massachusetts.

GENTLEMEN,—In accordance with the request of the Board, I have devised a project of harbor lines for that part of the Inner Harbor of Boston which includes the frontage of the city proper; of Charles River, from West Boston Bridge to the United States Navy Yard; of Fort Point Channel, from Dover-street Bridge to its mouth; and the frontage of the South Boston Flats, including the reclaimed and unreclaimed territory as far as Slate Ledge.

I have made the localities referred to a subject of first consideration, from the fact, mainly, that they embrace the oldest and most firmly established business portions of the city bordering upon the harbor, where change is least likely to be demanded, and where it is least practicable to effect it; and also because these lines of frontage form the best bases for extending the project over localities where, perhaps, a less rigid system of harbor line may be required.

The basin of Charles River above West Boston Bridge has been the subject of recent treatment and change in its harbor lines; and still further modifications are contemplated. It seems, therefore, at this particular time, or until the final purpose and character of the basin is determined, inexpedient to revise the present lines. For similar reasons it seems inexpedient at this time to modify the harbor lines in South Bay above Dover-street Bridge.

A further study and examination of various elements which enter into a proper system of harbor lines applicable to Chelsea Creek and Mystic River require more time and preparation than can now be given to them, in order to lay the results before the Board, together with the project herewith proposed.

For the frontage of East Boston, further data and examination is desirable before a suitable system of harbor lines can be devised, and proper continuity with the lines of Chelsea Creek be effected, as well as to secure a better basis for extending the lines eastward, so as comprehensively to provide for and define the improved frontage contemplated by the East Boston Company and the Boston Land Company.

Without entering into a discussion of the principles of compensation or the complicated physical condition of the harbor, it is important to state that the new harbor line so closely follows the present configuration of the harbor outline, as formed by actual structures, — most of which

have been standing for so long a time that the impressions due to their condition and position have already been effected,—that no physical influences caused by such slight deviations from existing outlines as occur have been taken into account. The project has been based, mainly, upon the adjustment of water-spaces to symmetrical lines of frontage best adapted to navigation and occupation. Where the revised harbor line does deviate from the former line, and from existing outlines, it is for the purpose of correcting irregularities and improving the general alignment of the harbor frontage.

In order that the revised harbor line may clearly and in fact define the *actual limits* of the harbor, it has been so projected that it will in no case fall *within* any existing structure, except where it may cross the lines of bridges. In some cases it coincides with the outer faces of wharf structures as they now exist, and many of the initial points or points of deflection in it are coincident with the outer corners of present wharves, and the line has been projected with a view to the extension of other wharf and sea-wall structures to it; and it is desirable, if such structures are so brought out, they should coincide as nearly as practicable with the harbor line, while in no case should they extend beyond it.

A practical difficulty exists in carrying out this system where the frontage is defined by *one line* only, as in the former method, which has seemed to me to be an imperfect one for this as well as other harbors for which I have devised schemes of harbor lines. The question at once arises as to what part of the structures built in conformity to it shall coincide with the harbor line. If the coping, which is generally *understood* to be the line of coincidence in the former system, then all parts of structures having “batter” must extend beyond the line prescribed. If the foundation is the line of coincidence, then structures having unequal batter will present at their surfaces or copings a zigzag and irregular line.

To guard against these objectionable features in the scheme, and provide for the construction of more symmetrical lines within legally prescribed limits, I would respectfully suggest for the consideration of the Board the establishing of *two parallel harbor lines*, to be called the *coping and foundation lines*. The distance between these lines should be governed by the approved batter of frontage structures at a given depth. For the Inner Harbor of Boston that of twenty-three feet at mean low water as the standard depth of channel improvements would seem to be appropriate, or the foundation line may be located beyond the base of ordinary structures, so as to give full room for repairs, &c.; for the water-faces of city proper, and for Charles River and Fort Point Channel, a distance of ten feet between the coping and foundation lines would be sufficient to include all probable structures; for the heavier sea-walls of the South Boston Flats and similar structures, twenty feet would be sufficient. By such a system of harbor lines, a symmetrical surface or coping line can be established at a given elevation,—the coping of the dry dock at the United States Navy Yard in Charlestown would be a suitable plane of reference,—while the foundations and submerged portions of all structures can be constructed within lines which shall *in fact* restrict all

encroachment upon the water-spaces reserved by law for navigation and other harbor purposes.

The loss of initial points and the indefiniteness in direction and extent of the old harbor line are probably largely due to unauthorized encroachments. To guard against the future occurrence of this abuse, it might be well to attach a definite penalty to each transgression of the harbor line, and insert a clause to this effect in the licenses granted.

An important feature in the work is the accurate determination and permanent marking of the points in the harbor line. Experience has proved that reference to local objects, even of apparently stable character, is insecure; and this fact was one of the reasons and requirements for a resurvey of the wharf-lines of the upper harbor, and for basing it upon the costly and perfectly determined triangulation of the United States Coast Survey,—the main points in this triangulation being so securely marked as to preserve them from the probable contingencies of accident. It was also a feature in the scheme of the resurvey to connect each initial point or point of deflection in the harbor line with the points in the harbor triangulation; in fact, to make the points of deflection in the harbor line actual points of triangulation. A practical difficulty, however, arises in the execution of this plan, from the fact that many of the points of deflection in the harbor line will fall in *water*. It became necessary, therefore, to locate and determine by triangulation a point on some actual structure which would be accessible for instrumental occupation, and where local marking could be made as near as practicable to each point of deflection in the harbor line as could not be marked, and to make these points of triangulation "*reference points*" from which the points of deflection in the harbor line could be determined by measured and computed distance and direction. The geographical position of each reference point, and each point of deflection in the harbor line, will be given in tables similar to those for the same class of data published in the last annual report of the Board.

The work of selecting and marking the points in the harbor line has been executed by Mr. William E. McClintock in a most thorough and accurate manner. Each reference point has been located with reference to its future connection with the harbor triangulation; and the observations and measurements referring the reference points to the points of deflection in the harbor line have been made with the same degree of accuracy which has characterized the determinations of the Coast Survey which are the bases of these more minute results. The number of reference points and points of deflection in the harbor line, which have been marked with the copper tacks and iron plates in the manner adopted, amounts in total to sixty-one.

The work of preparing and compiling the larger maps required for the study and project of the revised harbor line has been done by Mr. William T. Blunt in a most accurate and skilful manner. As Mr. Blunt has since left the service of the Board for duty with the Mississippi River United States Commission, I feel it due to him to acknowledge here his energetic and efficient service in connection with this work with the Board.

The only remaining work to be done, in order to make complete the

final determination of the harbor line, is that of the observations and computations connecting it with such points and lines in the harbor triangulation as form the best bases for the results required.

I present herewith the detailed description of the location and marking of the harbor line.

Respectfully submitted.

HENRY L. WHITING.

[C.]

STATEMENT OF OPERATIONS DURING THE YEAR ENDING DEC. 31, 1879, ON WORKS FOR THE IMPROVEMENT OF RIVERS AND HARBORS IN THE STATE OF MASSACHUSETTS, UNDER THE CHARGE OF B'VT. BRIG. GEN'L GEORGE THOM, LIEUT. COL. OF ENGINEERS.

I. — IMPROVEMENT OF BOSTON HARBOR, MASSACHUSETTS.

Operations for the improvement of this harbor by the United States Government have been carried on during the year ending Dec. 31, 1879, as follows: to wit, —

1. Under a contract made June 4, 1877, with Mr. George W. Townsend of Boston, Mass., for the breaking-up and removal of about 290 cubic yards of sunken ledges, situated in the main ship channel at the Upper Middle, and near Kelly's Rock in the outer harbor, the contractor broke up and removed to grade, in the years 1877 and 1878, all the ledges remaining in the main ship channel at the Upper Middle, and about 183½ cubic yards of that near Kelly's Rock, leaving 24½ cubic yards near Kelly's Rock to be removed under his contract. This work was resumed by the contractor on the 1st of May, 1879, and completed on the 12th of June, 1879, to the extent called for under his contract.

2. Under a contract made Aug. 15, 1878, with Mr. Joseph E. Bartlett of Boston, Mass., — the lowest of eight bidders, — for the removal of the Man-of-War Shoal (situated in the upper harbor at the confluence of Charles and Mystic Rivers) to a depth of 23 feet at mean low water by *dredging*, at 27 cents per cubic yard, measured in the scows, the contractor completed about 33,000 cubic yards of dredging on the 15th of December, 1878, when he suspended work for the winter. On the 24th of April, 1879, he resumed work under his contract, and has continued it up to the end of the year 1879, during which period he has dredged about 46,000 cubic yards additional, making a total of about 79,000 cubic yards to date; leaving about 5,000 cubic yards to be dredged by him to complete the removal of that shoal.

3. Under a contract made Aug. 26, 1878, with Mr. Isaac A. Sylvester of Quincy, Mass., — the lowest of three bidders, — for breaking up, and removing to a depth of 23 feet at mean low water, the only remaining sunken ledge near Kelly's Rock (containing 145½ cubic yards, measured *in situ*), operations were commenced by him on the 2d of July, 1879, and continued with much energy until its satisfactory completion on the 7th of November, 1879.

4. The reconstruction of the sea-wall, built in 1868 and 1869, at the

south-east bluff of Lovell's Island, was commenced in June, 1878, and was nearly completed on the 9th of December, 1878, when work was suspended for the winter. It was resumed on the 14th of April, and completed on the 21st of June, 1879. All the stone for this work was furnished by contracts, and all the work was done by hired labor. This sea-wall has been increased in thickness and height, and has had a new granite paving placed in its rear, and a rubble-stone apron built in front for the protection of its foundation; and it is believed that it will now be able to resist the violent storms to which it is exposed, and effectually protect and preserve this part of the island.

5. The sea-walls on Gallop's Island, Long Island, Point Allerton, and Deer Island, have all been repaired where most necessary during the past year.

The appropriation of fifty thousand dollars made by Act of Congress, approved March 3, 1879, for the improvement of Anchorage Shoal, the channel at the Lower Middle, and the upper harbor near the mouth of Mystic River, having been made available therefor by the War Department on the 30th of July, 1879, proposals were at once invited for dredging at those places; and the following contracts were made: to wit, —

6. On the 28th of August, 1879, with the New England Dredging Company of Boston, Mass., — the lowest of two bidders, — for

(a) 38,000 cubic yards, more or less, of dredging at Anchorage Shoal, for obtaining a depth of 23 feet at mean low water, at 74 cents per cubic yard, measured *in situ*; and

(b) 6,000 cubic yards, more or less, at the Lower Middle Shoal, for obtaining same depth as above, at 84 cents per cubic yard, measured *in situ*.

Operations were commenced at Anchorage Shoal, under this contract, on the 15th of September, 1879, and were continued up to the 17th of December, when they were suspended for the winter; resulting in 9,937 cubic yards of dredging *in situ* to that date, whereby the channel has been opened to the required depth for a width of about 350 feet.

7. On the 11th of September, 1879, a contract was made with the New England Dredging Company of Boston, Mass., — the lowest of four bidders (after proposals had been twice invited for the work), — for 50,000 cubic yards, more or less, of dredging in Mystic River, near its mouth, for obtaining a depth of 23 feet at mean low water, at 33 cents per cubic yard, measured in the scows. Operations were commenced under this contract on the 2d of October, 1879, and have been continued up to the close of the year, resulting in about 26,000 cubic yards of dredging under said contract.

The dredging to be done at Anchorage Shoal under the present contract (*viz*, 38,000 cubic yards, more or less, measured *in situ*) will open a channel of the projected depth to a width of about 600 feet; whereas the full width projected is to be not less than 1,000 feet, which will require about 80,000 cubic yards of additional dredging.

The dredging contracted for at the Lower Middle Shoal (to wit, 6,000 cubic yards, more or less, measured *in situ*) will open the channel at that place to the full projected width of not less than 650 feet.

The dredging contracted for in Mystic River (to wit, 50,000 cubic yards, more or less, measured in scows) will open a channel of the projected depth to a width of about 100 feet throughout the whole length of the shoal; whereas the full width projected is 300 feet.

From the foregoing statement, it is seen that the work that now remains to be done under the present contracts consists of—

1. The completion of the contract made Aug. 15, 1878, with Mr. Joseph E. Bartlett for the dredging at the Man-of-War Shoal, of which about 5,000 cubic yards now remains to be done.

2. The completion of the contract made on the 28th of August, 1879, with the New England Dredging Company for the dredging at Anchorage Shoal, of which about 28,000 cubic yards remains to be done; and about 6,000 cubic yards of dredging at the Lower Middle Shoal.

3. The completion of the contract made Sept. 11, 1879, with the New England Dredging Company for the dredging at Mystic-river Shoal, of which about 24,000 cubic yards now remains to be done.

The work that has been *completed* up to the 1st of January, 1880, for the improvement of this harbor, consists of the following: viz.,—

- I. The main ship channel has been straightened, widened, and deepened, so as to have a width of not less than 600 feet, and a depth of 23 feet at mean low water at the following places: viz.,—

1. At the west end of Great Brewster Spit.

2. At the south-east and south-west points of Lovell's Island.

3. At the Upper Middle Bar.

Whereby this channel, from the entrance of the lower harbor up to Anchorage Shoal, has a width of not less than 600 feet, and a depth of 23 feet at mean low water (or about 32½ feet at ordinary high water), except at the Lower Middle, where it requires widening.

- II. *Sea-walls* have also been built, for the preservation and protection of the headlands in the harbor, at Point Allerton, Great Brewster Island, Lovell's Island (north and south-east heads), Gallop's Island, Long Island (north head), Rainsford Island, and Deer Island (north, middle, and south heads); which are now generally in good condition.

- III. *Sunken rocks* have also been broken up and removed as follows: viz.,—

Kelly's Rock and all the known sunken ledges near it, Tower Rock, Corwin Rock, the ledges recently discovered at the west end of Great Brewster Spit, and between there and George's Island (all situated in the main ship channel at "the Narrows"), to a depth of 23 feet at mean low water. Barrel Rock in Broad Sound, State and Palmyra Rocks, situated about one-half a mile east of Castle Island, have also been removed.

Surveys and estimates have also been made, and appropriations asked, for completing the following additional work now projected for the improvement of this harbor:—

1. For completing to a least width of 1,000 feet the main ship channel at Anchorage Shoal	\$60,000 00
2. For completing to a width of 300 feet the main ship channel in Mystic River, in the upper harbor	35,000 00
3. For straightening, widening, and deepening the main channel in the upper harbor, from the mouth of Charles River up to Western-avenue Bridge, and thence up to the head of tide-water at Watertown	74,600 00
4. For the repairs of the several sea-walls built for the preservation of this harbor	5,000 00
Adding for engineering expenses and other contingencies, say, ...	20,400 00
Total	\$195,000 00

II. — MERRIMAC RIVER, INCLUDING THE HARBOR OF NEWBURYPORT, MASSACHUSETTS.

I. *Merrimac River above Newburyport, Mass.* — Under the appropriation of five thousand dollars made by the River and Harbor Act of March 3, 1879, the improvement of this river has been continued at the falls between Haverhill and Lawrence, Mass., under an arrangement made with the Pentucket Navigation Company, by which, since the 1st of September last, the channel at the Upper Falls has been straightened and widened, and in some measure improved at the Lower Falls. Numerous sunken bowlders have also been removed from the river at the Upper Falls, Lower Falls, Hazeltine Rapids, and below. The only projected work that now remains to be done at these falls is the removal of a sunken ledge at the Lower Falls, which it is contemplated to have done next season with the funds now available therefor.

By these improvements at the falls, the channel will have 3 feet of water up to the head of tide-water at the foot of the Upper Falls in the lowest stages of the river, at *low tide* with the mill-water at Lawrence *not* running, and about 5 feet of water with the mill-water *running*; whilst at *high* water, with the mill-water *running*, there will be about $7\frac{1}{2}$ feet of water. At the Upper Falls (above tide-water) the channel (as now completed) has a depth of about $4\frac{1}{2}$ feet in the lowest observed stages of the river with the mill-water *running*.

The following work has also been done (in the years 1870–78) for the improvement of this river: viz., (1) the rocky shoals dredged, and numerous sunken bowlders removed from the channel, at and near Rock's Bridge (six miles and a half below Haverhill), including Currier Rock above, and Petty Rock below, the bridge, — greatly improving this the most dangerous part of the river below Haverhill; (2) the channel opened by dredging, for a width of 100 feet, to a depth of 12 feet at ordinary *high* water, at Currier's Shoal (about four miles below Haverhill); (3) also, to the same depth and for a width of 75 feet, at the shoals near the head and foot of Silsby's Island (about one mile below Haverhill); (4) and at Haverhill the shoal between the two bridges has also been improved by dredging, so as to have a channel 10 feet in depth at ordinary *high* water. The above improvements comprise all that have hitherto

been projected for this river below Haverhill, with the exception of the removal of some more bowlders at Rock's Bridge, for which an appropriation of one thousand dollars has been asked.

2. *Newburyport Harbor, Mass.* — Under the appropriation of ten thousand dollars made by the River and Harbor Act of June 18, 1878, a contract was made Aug. 10, 1878, with Mr. Isaac A. Sylvester of Quincy, Mass., — the lowest of five bidders, — for breaking up, and removing to a depth of 9 feet at mean low water, 300 cubic yards, more or less, of the North (Gangway) Rock, at \$28 per cubic yard, measured *in situ*. Work was commenced under this contract on the 24th of August, 1878, and continued up to the 20th of December, when it was suspended for the winter, during which period about 170 cubic yards of the ledge was broken up, and removed to grade. Operations were resumed by the contractor on the 16th of April, and completed on the 28th of June, 1879, in which time $135\frac{4}{5}$ cubic yards of the ledge was removed to grade, making a total of $305\frac{4}{5}$ cubic yards removed under and in completion of his contract. By this work the channel has an increased width of 60 feet for a depth of 9 feet at mean low water.

In the year 1870 Gangway Rock (situated about 70 yards to the south-east of North Rock) was for the most part reduced to the same grade, — to wit, 9 feet below the plane of mean low water; and the sunken wreck of the schooner "Globe" was also removed.

The additional work projected for the improvement of this harbor consists of (1) removing to grade still more of North Rock, so as to increase the channel 20 feet more in width for a depth of 9 feet at mean low water; (2) completing the removal, to the same grade, of Gangway Rock; (3) the removal, to the same grade, of South Gangway Rock, situated about 120 yards to the south-east of North Rock; (4) breaking up and removing the ledge in the upper harbor, known as "the Boilers," to a depth of 5 feet at mean low water; (5) removing four sunken piers from the channel near the entrance of the harbor abreast of Black Rock's Creek; (6) removing a large sunken bowlder from the channel between the north and south piers. The estimated cost of these improvements is twenty-three thousand dollars, for which an appropriation has been asked; making a total of twenty-four thousand dollars asked for both river and harbor.

III. — PLYMOUTH HARBOR, MASSACHUSETTS.

By the River and Harbor Act of June 18, 1878, the sum of five thousand dollars was appropriated for the improvement of this harbor, about half of which was expended, in 1878, in the extension of the stone bulkhead at the outer end of Long Beach, and in the repairs of other works on that beach where most necessary. This work was resumed in June, and was completed in November, 1879, for a length of about 700 feet along and outside of the wooden crib-work bulkheads, now much impaired by age and storms. This bulkhead, as extended, will give better and more permanent protection to the outer end of the beach.

During the past year all the necessary repairs have been made, and all

the works on the beach are now in a good, effective condition; but, exposed as they are to injury from violent easterly storms, they will necessarily continue to require occasional repairs. These works have been built, from time to time, for the protection and preservation of Long Beach, upon the existence of which this harbor depends. They consist of bulkheads, jetties, and groins, built for the accumulation of sand; and the planting of beach-grass, also to accumulate sand and give permanency to the beach thus formed, whereby a ridge has been formed throughout the whole extent of the beach, which is for the most part covered with beach-grass.

For the improvement of the harbor itself, the sum of ten thousand dollars was appropriated by the River and Harbor Act of March 3, 1875, by which a channel was opened from the Middle Ground up to Long Wharf, a distance of about 2,500 feet, to a depth of 6 feet at mean low water (or 16 feet at mean high water), and for a width of 50 feet.

The project originally provided for a channel, 100 feet in width, to be extended southward to the mouth of Town Brook, a distance of about 900 feet above Long Wharf, so as to form a basin in front of the wharves of the city, 125 feet in width, with a depth of 8 feet at mean low water.

For the completion of this project, the additional sum of twenty-five thousand dollars was asked in my annual report to the Chief of Engineers for 1878, since published by Congress. By the River and Harbor Act of March 3, 1879, the sum of thirty-five hundred dollars only was appropriated for this work; but it has been decided to wait for an additional appropriation before doing any thing further towards its completion.

IV. — PROVINCETOWN HARBOR, MASSACHUSETTS.

All the works projected for the preservation and improvement of this harbor have been completed, except the extension of the stone bulkhead on Long Point. These works are now in good condition, and fully answer the purpose designed. They will, however, require continual watching and occasional repairs, for which purpose an additional appropriation of one thousand dollars has been asked.

Under the appropriation of one thousand dollars, made by the River and Harbor Act of March 3, 1879, 544^{48.0}₂₄₀ tons of rubble-stone has been placed on the bulkhead on Long Point, in extension of the same, during the past season.

[D.]

STATEMENT OF OPERATIONS DURING THE YEAR ENDING JUNE 30, 1879, ON WORKS FOR THE IMPROVEMENT OF RIVERS AND HARBORS IN MASSACHUSETTS, UNDER THE CHARGE OF B'VT. MAJ. GEN'L. G. K. WARREN, LIEUT. COL. OF U. S. ENGINEERS.

WOOD'S HOLL HARBOR.

Surveys of this harbor were made in 1873 and 1878, and fifteen thousand dollars appropriated by Congress for dredging and improving its channels. It is understood that considerable work has been done in removing rocks and bowlders since the report of Gen. Warren was made up.

TAUNTON RIVER.

Two thousand dollars appropriated by Congress in June, 1878, has been expended during the succeeding fiscal year in the removal of 232 cubic yards of bowlders from the channel between Weir and Dighton, a distance of six miles.

Wm. P. Hunt

PUBLIC DOCUMENT.

No. 11.

ANNUAL REPORT

OF THE

HARBOR AND LAND COMMISSIONERS

FOR THE YEAR 1880.

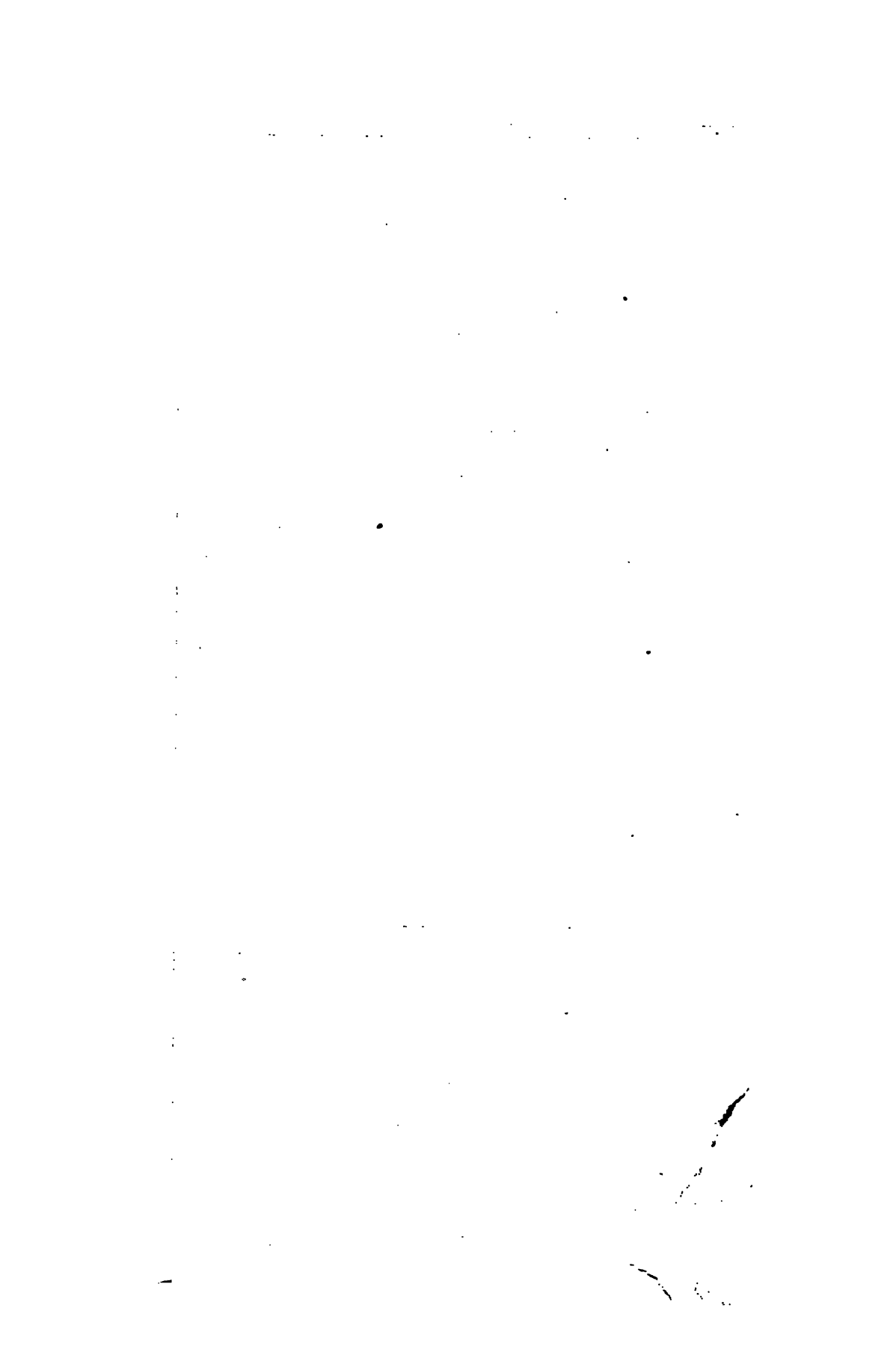
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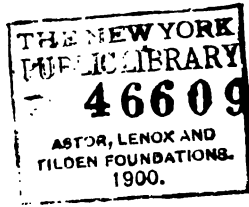
1881.





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1881.



Commonwealth of Massachusetts.

HARBOR AND LAND COMMISSIONERS' REPORT.

To the Honorable the Senate and the House of Representatives of the Commonwealth of Massachusetts.

THE Board of Harbor and Land Commissioners, in accordance with the provisions of law, respectfully submit their annual report for the year 1880.

SOUTH BOSTON FLATS.

The total cost of this land to Dec. 31, 1880, has been, \$1,148,847 69

The receipts have been, —

From Boston and Albany Railroad, for land, \$330,000 00

From New York and New England Railroad,
for land 1,108,165 00

From New York and New England Railroad,
for rent 10,500 00

From Boston Wharf Company, for land 1,354 20

1,450,019 20

Showing, exclusive of interest, a profit to the Commonwealth, to Dec. 31, 1880, of

\$301,171 51

From this statement it appears that the aggregate amount of sales, and the amount received for rents, &c., of the South Boston lands, already exceeds by the sum of \$301,171.51 the whole amount expended by the State at South Boston. And there is still a large sum due from the Boston and Albany Railroad, for its purchase of fifty acres, besides damages for non-fulfilment of contract.

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The sales above reported cover all the filled land at South Boston, and leave belonging to the Commonwealth some seven hundred acres of flats, upon a very small portion of which has money been expended for reclamation; and, with active work, it will take two years to prepare for use a single dock and the adjoining piers.

On the 28th of August last, a contract, of which a copy will be found in the Appendix, was made with Thomas Potter for dredging three hundred thousand yards of material from the flats beyond the line of the proposed outer wall, and placing the same upon the flats proposed to be filled, the whole work to be completed by the 1st of January, 1883. This contract has been duly approved by the Governor and Council. It exhausts the appropriations already made; and a further appropriation will be necessary in order to complete retaining-walls, and walls for the required dock, so that the work upon the walls may be prosecuted simultaneously with the filling. By the Act of 1878, Chap. 237, the fund called the Commonwealth's Flats Improvement Fund is established; and by the same act it is provided that proceeds of land at South Boston, when sold, shall be placed in this fund. From this fund an appropriation was made by the same act; and it is now asked that a further appropriation may be made from the said fund, sufficient for the purposes named, so that without further delay the necessary additional contracts may be made. ✓

After the sale of the filled land was made, it was deemed advisable that the commission should obtain such knowledge of the construction, arrangement, and management of docks in Europe, as would enable it to make that use of the South Boston Flats which would conduce most to the advantage of trade, and meet its requirements, at the same time having due regard to the interests of the State. His Excellency concurred in this view; and one of the commission has visited Europe for these purposes, and has submitted to the Board a report of his examinations as follows:—

To the Board of Harbor and Land Commissioners.

GENTLEMEN, — Deputed by the Board, with the approval of his Excellency, to visit Europe for the inspection of docks and their connections with railroads, and especially to examine their systems of organization and management, I have the honor of submitting my report.

The first thing which attracted my attention, as I inquired about docks in Europe, was the great amount of work on docks which was in progress, contemplated, or just completed, in almost every port, whether great or small, throughout Great Britain, France, Belgium, Holland, and Germany. This work is to be attributed to two causes, —

1. The necessity of docks suited to the change of vessels from sail to steam; the latter requiring greater length of quayage, with wide sheds and broad landings, and a greater depth of water.

2. The necessity of preparing all ports which exported their special products to the ports of America, for the reception of the steamers which bring American produce or merchandise, because, with vessels such as are fitted for the Atlantic trade, it is impossible for them to discharge at one port and load at another. The models of the ships which do not permit their moving about, as sailing ships did, with swept holds or lightly ballasted, the long detention and double port charges, prevent and make it too costly. Therefore, for such ports it is necessary, in order to secure cheap and reasonable freights upon their exported products, to be able to accommodate with proper docks and railroad connections, all ships which may bring imported goods to the port. And so by being able to receive inward cargoes, ships are secured at the port for outward cargoes. In other words, such a port with good docks and railroad connections may establish a line of steamers to America which will be sure of cargoes both ways.

That the trade with America is of great importance, is shown by the fact that while the receipts of the Mersey Dock and Harbor Board for dock rates and tonnage rates during the year ending July 1, 1880, were £740,000 sterling, £360,000 sterling were collected from the United States trade, and £60,000 sterling more from the trade with the British North American provinces; or, nearly 57 per cent of these receipts were from the trade with North America.

In Great Britain one finds docks fitted for this trade, either just completed or in progress, in the ports of London, Liverpool, Hull, Newcastle, Hartlepool, Leith, Glasgow, Barrow, Fleetwood, Belfast, Bristol, Swansea, Cardiff, Newport, Plymouth, Southampton, and perhaps other places. In France, at Dunkirk, Havre, Bordeaux, and Marseilles. In Belgium, at Antwerp. In Holland, at Amsterdam and Rotterdam. In Germany, at Bremerhaven and Hamburg. The amount expended and to be expended is many millions in sterling.

In Amsterdam a canal fifteen miles long has been cut through to the North Sea, so that the port is no longer entered round the Texel and through the shallow Zuyder Zee, but is now a deep-water harbor, and twenty-four hours nearer the Atlantic trade than before. The canal is said to have cost five million dollars, and the docks being constructed will cost as much more. In Rotterdam docks, where the steamers in the American trade discharge and receive their cargoes, twenty-one millions of guilders, or over eight millions of dollars, have been expended. In Antwerp, a city which has lain almost dormant for three centuries, the docks built by Napoleon have been enlarged, deepened, and re-modelled, new docks are being built, and the whole water-front of the city changed to

insure deep water and regularity in the tidal flow, at a cost of many millions of dollars; and the city with its lines of steamers, and immense number of sailing vessels in the American trade, has become to-day the third or fourth commercial city of Europe. In Hamburg and Bremen large sums have been expended, and lines of steamers to America established. These five ports are to-day in competition for the great trade between America and Germany.

The four ports of France put the various portions of that great nation into direct communication with America; and their docks, their conveniences, and their cost are on the same scale as the docks in Germany, Holland, and Belgium. Indeed, it is a point very difficult to decide, as to which has the best, or which has expended the most. But all look to the American trade for their greatest revenue.

The ports of Great Britain are familiar to you by name. London and Liverpool are general ports, while most of the others are special ports. In most of the special ports there must have been expended a million of pounds sterling, and in some of them more. In the River Clyde, which fifty years ago was not navigable to Glasgow by ships of one hundred tons, there is now twenty-five feet of water, and there are ample docks, two or three lines of steamers to America, and the great ship-yards where are built a large proportion of the steamers now engaged in the American trade. The cost of making such a port, as Glasgow now is, has been many millions.

And so the various other ports might be described; but the plans of their docks, which you now have, will afford you ample information in regard to their plans and construction.

In London the great Victoria and Albert Dock, two miles long, has cut off a bend in the river, which it enters at either end; and here may be found the great steamers running to Boston and New York. So far as possible, every improvement has been introduced, and both here and at the East and West India Docks, every attempt has been made to facilitate business and to lessen charges in the handling of goods.

When I landed at Liverpool, the engineer of the Mersey Docks, Mr. Lyster, told me that in the handling of goods America had little to learn in Europe, and that he had sent his assistant to America, last year, to examine our system of handling goods in order that he might introduce in his new docks and warehouses now building in Liverpool all American improvements. Still he said there was one thing in which Europe was in advance of America, and that was the use of hydraulic machinery. This I found to be true, and no dock visited was found without large hydraulic engines and hydraulic cranes. But it was laughable at times to see how goods were handled so carefully, so easily, and so cheaply, by this splendid machinery, and then to see the whole saving wasted. For instance, at Antwerp a vessel with broken pig-iron was being discharged by one of the beautiful hydraulic swinging cranes of Sir William Armstrong. The iron was hoisted from the hold in a large tub, which, instead of being swung over to the car standing upon the track only fifteen feet away, and then dumped, was lowered to the deck, and then the iron was handled piece by piece, and placed in a basket, the basket placed upon a

man's shoulder, and the man walked down a plank to the dock, up another plank on the further side of the car, and then dumped his basket into the car. It was in vain to ask why the tub was not swung and then dumped, — they never did it so.

In London, with a hydraulic crane lying idle alongside the ship, bale goods were rolled from the car down to the pier, and then rolled up again to the vessel's deck. To the question "Why do you do so?" the answer was, "We always have."

In Liverpool, where grain is raised by hydraulic power to the highest story of the magnificent grain warehouse, and carried by a horizontal belt, moved by hydraulic machinery, at the rate of fourteen feet in a second, eighty tons of it in an hour, — with a railroad station two hundred feet away, the grain is lowered to the lowest floor, shovelled into a sack, the sack carried to a truck, and by the truck carried to an open car, upon which it is loaded, covered with a tarpaulin, and transported to the country. Mr. Lyster has tried in vain to extend his belt to the station. The railroad company says No, and grain is handled as it has always been. Thus, while science shows the way, and engineers desire to use the improvements which they have constructed, prejudice and custom say No, and absorb the saving of improved machinery. But in other places where they deal with their own products, prejudice and custom do not always interfere with science. In Newport there is a dock two thousand five hundred feet long, one side of which is devoted to coal shipments. Here science has had full sway. Parallel to the dock, and three or four hundred feet away from it, is the railroad track, elevated seven feet above the capsill. Upon this track the loaded cars come in, each car of four wheels holding eight tons of coal. At intervals of three or four hundred feet, there are switches from which curved tracks run to the capsill of the dock, on a descending grade. Upon these curved tracks the loaded cars are switched off. At the end of each track is a hydraulic lift, upon which the loaded cars are placed one at a time. One man handles the cars, and one man tends the lift. Every two minutes a car is raised fourteen feet, dumped by an opening at the end, tipped back on to a descending track which runs back on a curved line to the main track; and so, with only two men, coal is loaded into a single hatch of a vessel, at the rate of four tons to the minute, — an example of the rapidity and cheapness with which goods are handled when men will use the appliances which science furnishes.

This use of hydraulic machinery and gravitation was the most noticeable thing in connection with the handling of goods. Its simplicity and cheapness should attract attention, and wherever the two powers can be combined they should be used. But it is not merely for the handling of goods that hydraulic machinery is used in Europe. The docks there are mostly docks into which vessels can come only at high water, owing to the great rise and fall of the tide. At high water the gates are opened, and vessels pass in and out. Then the gates are closed, and high-water mark is retained inside the docks all the time, so that vessels lie constantly afloat, with their rails always at the same distance from the capsill of the dock. And it is to open and shut these great gates requir-

ing immense power, that hydraulic machinery is used. It is also used to pump out the graving docks which are found inside all first-class docks in Europe. The modern graving dock is over five hundred feet long, sixty feet wide, with twenty-five to thirty feet water over the sill. Such a dock as this is pumped dry in Liverpool by hydraulic machinery in less than an hour; and one of the largest steamers, the "Scythia," entered this dock, and went out in eleven hours, having been painted and cleaned in the interval, — the eleven hours being in the night, so that no time was lost. At the dock electric lights are used, so that men can work as well by night as by day.

The other noticeable thing in regard to docks is their common use by all on equal terms. There, railroad companies do not own and control docks, charging other railroads for their use, but in all cases the railroad tracks upon the docks and to the junction with railroads are owned by the dock company, which loads the cars and carries them to the junction, or receives them at the junction and unloads them, the charge to all railroads being the same. This is exemplified by the following advertisement of the Royal Victoria Docks at London: —

IMPORT GOODS. — There is no extra charge for delivery to railway trucks. The following railway companies have goods depots within the Victoria Docks, and the trucks run alongside the warehouses, viz.: Great Eastern, Great Northern, London and North-western, Midland, and, by special arrangement, the Great Western. Grain, flour, guano, provisions, and goods of every description, handed to above companies, as a rule arrive at destination the following morning, thus saving much time and risk; and no expenses for cartage or lighterage are incurred.

This list of railroads covers the principal companies in Great Britain. To each of these railroads cargo from any vessel in those docks can be delivered, and from each of these railroads any vessel in the docks can receive goods, at precisely the same cost per ton. In Liverpool it is the same. The three railroads there, the North-western, the Midland, and Great Western, have equal privileges. And so it is all over Europe. To whichever dock in whichever port a vessel goes, her cargo goes on equal terms to every railroad which has a track within the limits of the port, and from every railroad in the port cargo can be received on equal terms. In this country no such custom prevails. The great termini are owned by railroad corporations. Not to every railroad are allowed equal terms, but only to every railroad other than the owner. Thus vessels which in this country lie at a railroad terminus cannot receive cargo from, nor deliver cargo to, all railroads upon equal terms. The rate to all other railroads is different from the rate to the railroad at whose terminus the vessel lies. Freight to other railroads pays a terminal charge to the railroad owning the terminus, and a general cargo for different destinations must pay a charge or be sent over the road which owns the terminus. This may work well for the railroad, but it is against the public interest, and is injurious to the port. In Europe, if two railroads compete with each other, they bear the loss of the competition. Here, if they compete, the importer of goods does not get the whole benefit, because of the terminal charge to other railroads.

A merchant of Boston whose goods are at the Grand Junction Wharf cannot send his goods West by the Fitchburg or Lowell except by paying a terminal charge; nor can a vessel at either Constitution or the Lowell Wharf send goods West by any railroad except the railroad owning the terminus, unless he pays a terminal charge. This detracts from the advantage of Boston as a port. If the European system were adopted here, and ships lying in a foreign port could take freight for Boston to be sent thence by all railroads upon equal terms, the advantages of Boston would be more fully appreciated. Then steamers could come here assured that, at whatever dock they unloaded, they could at the same dock load from any railroad or from several railroads upon the same terms. Now a vessel coming to either wharf must load at the same wharf with such cargo as the railroad can furnish, or must haul to the wharf of another railroad to take the cargo which that road can furnish, or else the terminal charge comes in. Here it is, "Haul your vessel, or load with what we can give you by our cars." In Europe it is, "Stay where you are. Goods by all railroads will be brought to you on equal terms." Whether the system here can be changed, is worthy the consideration of both the legislature and the business men of Boston.

LIVERPOOL DOCKS.

But, while in so many ports in Europe there are docks which attract attention by their extent and convenience, it is in Liverpool that the most complete system of docks is to be found; and here is found also a form of management which secures uniformity of rates in the whole port, and to the business community the advantage derived from doing a large business. Here is found an inducement to extend business, so that the cost of doing it may be reduced; and here is found an immense corporation, without stockholders and without capital, managed and controlled by the men who contribute to its revenue; a corporation consisting of a large property, paid for by notes and bonds amounting to sixteen million pounds sterling; secured, not by a lien upon the property, but only on its income, and from the payment of which only one hundred thousand pounds sterling can be set aside annually from surplus receipts, if the surplus receipts amount to so much. This loan, though representing the cost of improvements, is really a loan, based solely upon the continued prosperity of the port, and bears interest at rates varying from three per cent per annum, to four and one-half per cent. The sinking-fund with its accumulations amounts to one million two hundred thousand pounds sterling.

The first dock in Liverpool was of three acres, 1,890 yards in extent, and was opened in 1715. In 1800 the dock area had reached 27 acres and 1,912 yards. In 1825 there were 46 acres and 3,179 yards. In 1840 there were 95 acres and 1,954 yards. In 1850 there were 152 acres and 381 yards. In 1857 there were 192 acres and 129 yards. Up to this date, all works had been constructed by the town of Liverpool, under authority of Parliament, and from time to time there had been built upon the Birkenhead side of the Mersey several docks, which on the 1st of January, 1858, had an area of seven acres and 360 yards; so that the total area of

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docks upon both sides of the Mersey was 199 acres and 489 yards. At this time was passed the Consolidation Act, by which all the docks upon both sides of the Mersey were placed in the hands of the Mersey Dock and Harbor Board, as perpetual trustees. To the town of Liverpool was allowed the sum of one million five hundred thousand pounds sterling for the surrender of certain rights transferred to the new Board, and such further sum as the town had expended, and to the Birkenhead Dock Company, a sum to be settled as provided by law.

The directors consist of twenty-eight members — eight elected each year, whose term of office is three years — and four members appointed by the Mersey Conservancy Board. The twenty-four members of the Board are chosen from those who, residing within ten miles of Liverpool, have paid dock rates to the extent of twenty-five pounds sterling during the previous year, by those persons who have the same qualifications. In this Board are vested the whole care of the docks, the duties of pilot commissioners for the River Mersey, the duties of harbor commissioners for the river, the exclusive right to build docks, the right to build railroads and to operate them within their own property, and the right to build across (over or under) streets, to discontinue streets, and to make new streets, subject to approval of the town of Liverpool, and to extend railroad tracks to connection with other railroads; and many other rights properly guarded as may be found necessary, and to fix all dock and tonnage rates, harbor and light dues, and rates for pilotage. But they must apply to Parliament for authority to borrow money for further improvements, and must fix the dock rates at such sum as will pay cost of maintenance, management, operation, interest, and the one hundred thousand pounds sterling for the sinking fund; no portion of the receipts beyond the one hundred thousand pounds sterling per annum being applicable either to a reduction of the debt or further improvements. No member of the Board can receive any compensation for his services, but all employés are paid. Thus it will be seen, that, with increased business, rates must be lessened to the advantage of those doing business in Liverpool.

This is the corporation which now manages and controls all the docks upon the Mersey. In 1860 its dock area was 334 acres, 1,189 yards; in 1870, 383 acres, 811 yards, and in 1880, 433 acres, 4,823 yards. And there are now very great improvements in progress, both at the North and South Ends, the most important of which is the great steam dock at the North End, upon which have been expended one million eight hundred and thirty-six thousand pounds sterling (three hundred and forty-six thousand pounds of it in the year ending July 1, 1880). In this dock there will be three piers or quays, each fifteen hundred feet long, and three hundred feet wide, separated by docks of three hundred feet wide. Upon each quay will be two sheds upon the edge of the docks, each one hundred feet wide, with a street for teams and railroad tracks between them of one hundred feet in width. These quays will add nine thousand feet to the length of quayage, and will be used for the steamers in the American trade, eighteen of the largest of which can be accommodated at one time. Upon these quays will be the hydraulic

cranes, and every other known appliance for the prompt and cheap handling of goods. They are expected to be ready for use in 1881.

In the same dock basin will be graving docks, so that steamers can be repaired promptly, and without moving out of the basin in which they lie to discharge and receive cargo.

At the South End, also, are extensive docks in the course of construction, upon which the sum of three hundred and twelve thousand pounds sterling has been expended, eighty-two thousand pounds of it during the year.

It will be noticed that Liverpool has in construction new docks which have already cost over two million one hundred and fifty thousand pounds sterling, to be added to her present capacity of four hundred and thirty-four acres. The length of dock front upon the Liverpool side of the river is six and one-half miles; and upon the Birkenhead side some one and one-fourth miles, and back from the river about two miles. The total amount expended to 1st July, 1880, has been:—

At Liverpool	£10,727,627	12	7
Birkenhead	5,949,333	6	8
	£16,676,960	19	3
And the debt outstanding is	15,951,248	3	5
So that only	£725,712	15	10

of the cost, or about .0435 per cent, has been paid for.

The rest has been borrowed upon the security of the rates hereafter to be collected. The first dock was opened in 1715, so that in one hundred and sixty-five years the payments for the cost have averaged less than forty-four hundred pounds sterling per year.

The dock receipts were, in —

	Vessels.				Tonnage.
		£	s.	d.	
1752	—	1,776	8	2	—
1775	2,291	5,384	4	9	—
1800	4,746	23,379	13	6	450,060
1825	10,837	128,691	19	8	1,223,820
1840	15,998	178,196	14	0	2,445,708
1850	20,457	211,743	7	7	3,536,337
1860	21,136	397,315	12	11	4,697,238
1870	19,429	511,703	9	8	5,728,504
1880	20,070	706,449	12	8	7,524,533

The above table shows the constant increase of trade at Liverpool, and also shows the effect of the introduction of steam vessels upon their size, the number of vessels in 1850 being greater than in 1880, while in 1880 the tonnage had more than doubled. The dock area had also increased 200 per cent.

Thus I have described the docks at Liverpool, and their system of management. Such system exists nowhere else, I believe. In London,

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two great companies, not railroad corporations, but each owning its own tracks to the junction with the great railways, control three hundred and fifty-two acres of dock basins, of which the East and West India Dock Company own and occupy one hundred and twenty-seven acres, and the London and St. Katharine Dock Company two hundred and twenty-five acres. With each other these companies compete for business, and, in order to secure business, each arranges to deliver goods to all the railways upon equal terms. Upon the Continent, the docks are generally under government or municipal control, but in all of the Continental docks opportunity is afforded to all railroads to connect with the dock tracks upon equal terms.

So much I have learned by my visit abroad; and now you will ask me to apply it to Boston, and especially to the property of the State which is in control of the Board.

In the first place, then, let me say that, with the immense trade between Europe and America, Boston can have as much of it as she will prepare herself to accommodate, and that if she will secure to herself, as she can if she will, better facilities and lower rates than at other ports, the business will pour in upon her much faster than she can prepare herself for it. Already, with her imperfect arrangements, and her unfortunate system, there are more steamers in the port than can be accommodated, while the work of proper preparation will take much time. Let then, for the present, every facility be granted to every applicant for increased wharf accommodation. Induce, if you can, adjoining wharf proprietors to unite and make wharves suitable for steamers. Arrange, if possible, for the connection by rail of every wharf where a steamer can be placed with every railroad leading to places from which goods destined for the European market are brought, or to which they are carried.

The value of the property at South Boston, and the value of other wharf-property, will be increased and not diminished by the increase of business, whether that business be done either at the Mystic, at Charlestown, at East Boston, the city proper, or at South Boston; and at whichever point the greatest facilities can be furnished at the lowest charge, there will be the greatest business. It is a business of which there is enough for all, and there should be no rivalry except to excel among the wharf-owners of Boston. The aim should be to make the port of Boston, not East or South Boston only, but the whole port, superior to every other port in its accommodations, and possessed of greater facilities for distributing and collecting cargo, which shall be handled always at lower rates. The Commonwealth can have no rivalry with other wharf-owners. It will take years to put her property in condition to receive steamers or cargoes. If, in the mean while, business is not accommodated here, some other port will take it. If business continues to be done here, it will increase, so that, when the State can get docks upon her property, they will all be needed, and needed, too, more rapidly than they can be supplied. Clearly, then, it is not only the interest of the State, but the duty of the Board, to facilitate in every possible way the building of wharves and docks which will accommodate steamers of the largest size.

In other ports of the world it has been found necessary to make radical changes in the size and depth of docks, and in the arrangements of the piers and the buildings therein, so as to accommodate the necessities of steam navigation; and Boston must do the same thing if she desires to be a port of large trade with steamers. None of the cities in the Old World have escaped this, and the works now in progress in New York show how she is meeting the necessity. Let, then, the wharf-owners commence their work, and I am sure that the Board will aid them to the extent of its powers. Co-operation is the only thing which will change the present harbor front of the city proper into a series of piers and docks suitable for steamer's use. This co-operation should not be delayed. With it much can be done during the next summer to increase the facilities of Boston, and to make wharves, which to-day are of little value, very valuable in themselves, and of great assistance in increasing Boston's importance as a seaport. In East Boston, in South Boston, at Charlestown, both on the Charles and the Mystic, various parties are doing work which should be pushed forward without delay. With all these completed, still more room will be required, some of which, at least, must be found on the State's property at South Boston. To properly improve this, is, as I have said, a work of some years, and none of it can be made ready as soon as it is wanted.

And it is in connection with this property especially that my visit to Europe was made, and for the proper development of it that I have so closely examined and so fully reported the present management of the docks at Liverpool.

The property at South Boston belonging to the Commonwealth consists of some seven hundred acres of unfilled flats, of which perhaps one-half is especially fitted for railroad and shipping purposes. Under the existing laws this Board has the right, with the approval of the Governor and Council, to make "contracts for the improvement, filling, sale, use, or other disposition," of these flats; and an appropriation was made in 1878 for certain expenditures which existing contracts will absorb. An act authorizing the building of a junction railroad to the flats is also in force; but as there is now nothing belonging to the Commonwealth at South Boston except partially filled flats, which it will take much longer to prepare for use than it will to build a railroad, it is hardly probable that a railroad will be built until the lands are more nearly in condition for use. To the further loan of the State credit, even for improvements, there are strong and well-founded objections; and to the grant of even a portion of the land to parties who might make a large profit upon it there is also a strong objection. Yet the land remains, and, that there will be a demand for it as soon as it can be made ready for use, seems beyond question. If any corporation now authorized could be made a perpetual trustee, or if, in the absence of such corporation, a trust could be created, which should be authorized, the fee of the land remaining in the State, to borrow money upon improvements which should always be devoted to commerce, somewhat upon the basis of the Mersey Docks, and the management, like that of the Mersey Docks, to be in the hands of those who contribute to its revenues, and with such other provisions

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as would insure the reduction of charges as business increased, with no interest to be earned upon the cost or value of the land, but only revenue enough to pay the interest upon the cost of the improvements made, and the necessary expenses for operating and maintenance, the required improvements could be made without a donation of land, without the further issue of the State's credit, and without appropriations from the State treasury, provided the money for the proposed improvements could be obtained upon the same kind of security for improvements in Boston, as money is now and for many years has been obtained for improvements in Liverpool. This security is nominally the rentals of docks and piers, and the amount loaned is their cost; but the real security is the continuance of the great commercial trade of the port. While Liverpool continues a commercial port, there is confidence that a rental will be received, sufficient, at rates which will retain commerce against all competition, to pay the cost of maintaining and operating the docks there in addition to the interest upon their immense cost of nearly one hundred millions of dollars. If the same confidence exists as to the permanency of Boston's increasing commerce, there would seem to be no question of the ability of docks and piers, which pay no interest upon the cost of the land, paying an interest upon the cost of the improvements thereon, in competition with other docks and piers which must earn an interest upon the cost of both the land and the improvements, and therefore but little question as to the possibility of borrowing money in this country for all improvements which might be required from time to time. But, if there should be doubt about the loan being made here, I have good reason to believe that the money could be had in Great Britain, and probably at a low rate. There are two special advantages in this plan, besides those named: first, it devotes to trade permanently a large tract which can be utilized at the lowest possible rate for all time, and is therefore a benefit to both city and State; and, second, it will make the rest of the State property at South Boston of largely increased value.

Sometimes it is said that business passing through a place as it does through Liverpool, and will through Boston, is of no material benefit. Still, in Liverpool the Dock Board employ many thousand men, representing probably thirty thousand inhabitants of the city, who are paid directly from the revenue of the docks, besides which are the many men employed by the railroads in handling the merchandise received from or carried to the docks, which together represent a population occupying many houses, and requiring many tradesmen to supply their various needs; all of which business, besides the employment of the many men connected with the shipping, which, in its turn, employs many tradesmen, mechanics, merchants, and bankers, may be traced directly to the docks.

Such are the benefits of the adoption of the Mersey system in Liverpool; and, if my suggestions shall meet the views of the Board, I trust that such legislation may be recommended and secured as may enable work to be commenced and carried forward at South Boston upon a basis which, while it increases the value of the property of the State, will secure to Boston all the business which it can do with ships, and will enable her also, for all time, to do it at the lowest possible rates. If

this can be accomplished, even in a small degree, I shall feel that the time spent upon my trip has not been wholly wasted.

In conclusion, I desire to express my thanks especially to Messrs. George Warren & Co. of Liverpool, who were untiring in their efforts to secure to me all the information I desired; to Mr. Lyster, the engineer of the Mersey Docks, for his many courtesies, and for the time, information, and introductions which he secured to me; to Mr. Gittins, the secretary of the Liverpool Docks, for the valuable collection of documents furnished to me; to Mr. Forrest, the secretary of the Society of Civil Engineers in Europe, for his many courtesies, and especially for his letters of introduction to the engineers of the several ports which I visited; to the resident engineers of these several ports, for their kindness in furnishing me with every desired information; and to the various commercial houses and government officials who assisted me so much in my many inquiries.

WILLARD P. PHILLIPS.

Boston, December, 1880.

From this report, it is evident that many of the principal ports in Europe are actively at work in preparing docks suited to the requirements of the large steamers engaged in the American trade, the extent of which is shown in part by the large proportion of the whole trade at Liverpool; and the returns from the Liverpool docks show how largely the average size of ships has increased since the introduction of steam. All docks, therefore, which are intended for steamers should probably be at least as wide, and the piers as commodious; as those now building at Liverpool.

We agree with the views expressed in the report as to the probable extent of the trade in Boston if the proper facilities are furnished. We agree, too, in the suggestion that wharf-owners in Boston should secure, by co-operation and without delay, wharves suited for the accommodation of steamers. We agree, too, that the Board should aid by every means in its power the construction of new and the enlargement of old wharves. And we believe that all this will but add to the necessity of the rapid development of the property at South Boston.

We join, too, in the recommendation of the report that the attention of both the legislature and the merchants of Boston should be directed to the necessity of providing for the connection of all railroads with both the existing docks and with all new docks built, so as to add to the advantages and facilities of the port.

We have been especially interested in the report of the system of management of the Liverpool docks. It is a system which secures to commerce the lowest possible charges, every requisite convenience, and permanency. If it could be adopted here, it would place the control of business in the hands of the merchants themselves, and could not but add materially to the value of the Commonwealth's property at South Boston, even if one-half of it should be placed in a perpetual trust for the benefit of trade which it would constantly increase and develop. It would also avoid the use of the State's credit, and would make unnecessary any further appropriations. And we recommend such legislation as may be needed to make a perpetual trust, in whose hands should be placed such portion of the South Boston Flats as may be required and suitable for dock purposes, and that to such trust should be given such powers to borrow money for improvements, as the legislature may from time to time authorize, with the further authority to issue bonds secured by future rentals, with all necessary and proper restrictions. In the trust the State should be represented, as is the Conservancy of the Mersey in the Liverpool trust. The qualification of members of the board of directors should also be properly guarded. In the framing of such a bill very great care should be used, and it is very probable that even with all this care there would be some alteration or additional provision required before the lenders of money would be fully satisfied. This might cause the delay of a year, and cannot be afforded. Time is too valuable. While therefore we recommend such legislation, and most heartily approve of it, we also recommend further appropriations for the energetic continuance of work at South Boston. If the trust shall be created, and shall assume control of the South Boston property, the money expended by the State in improvements would be reimbursed from the proceeds of the first bonds issued; and that should be one of the conditions precedent of the trust. If these recommendations shall be followed, there need be no delay either in the formation of the trust or in the progress of the work of reclamation, and every thing will have been done which can be to prepare the State's property for the great business which will pour in upon it if it is seasonably prepared to receive it.

BACK BAY LANDS. ✓

		FEET.
In 1857 there belonged to the Commonwealth, in the Back Bay, so called		4,723,998
Of which there have been donated or transferred, —		
as per last report	314,740	
In 1880	48,568	
		363,308
Devoted to streets and passage-ways, as per last report		2,037,068.6
Sold, as per last report	2,084,931.6	
in 1880	110,857.45	
		2,195,789.05
Remaining on hand Dec. 31, 1880		127,832.35
		4,723,998
The gross proceeds of land sold have been		
as per last report	\$4,307,722 17	
In 1880	315,364 85	
		\$4,623,087 02
Rights in Parker Street sold as per last report	\$2,200 00	
In 1880	100 00	
		2,300 00
		\$4,625,387 02
Cost of filling, grading, &c., as per last report	\$1,626,008 71	
auction sales, as per last report	14,291 78	
		1,640,300 49
Net proceeds to Dec. 31, 1880		\$2,985,086 53

Of the whole land belonging to the State in 1857, only 46.48 per cent has been sold; the remainder, except 127,832.35 feet (2.706 per cent), having been given away or used in streets. The State has already received a net profit of 63.19 cents for every square foot owned by it in 1857; and the 2,195,789.05 feet already sold have averaged \$2.1054 per square foot gross; and, after deducting all the expenses of filling, the 4,723,998 feet have yielded a net profit of \$2,985,086.53, or \$1.3594 per square foot sold.

The land sold during the year, and its location, is as follows:—

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Area in sq. ft.	LOCATION.	Amount.
2,800. .	Marlborough Street, north side	\$9,800 00
25,345.6 .	Marlborough Street, south side	69,700 40
9,810.6 .	Commonwealth Avenue, north side	44,147 70
9,773.25 .	Commonwealth Avenue, south side	37,536 75
14,224. .	Newbury Street, north side	29,120 00
5,152. .	Newbury Street, south side	10,304 00
10,752. .	Boylston Street, north side	32,256 00
33,000. .	Boylston Street, south side	82,500 00
110,857.45	square feet, at an average of \$2.8447 Lowest price, \$2; highest price, \$5.	\$315,364 85

The prices show a general improvement upon the prices obtained last year; and, with the continued advance in the value of the land, it is expected that still higher prices will be obtained for the remainder.

Upon the sales of the land there was no charge of brokerage, the Commissioners having made the sales directly to the purchasers.

The land donated in 1880 was, —

	FEET.
To the city of Boston, for Public Library on Boylston Street, corner Dartmouth	33,000
To the State Normal Art School, Newbury Street, corner of Exeter	15,568
	48,568

The value of which was at least \$150,000.

The land still unsold is all beyond Dartmouth, and is located as follows, viz.:—

	FEET.
Marlborough Street (north side)	19,577.6
Commonwealth Avenue (south side)	6,411.75
Newbury Street (north side)	31,584
“ “ (south side)	26,208
	57,792
Boylston Street (north side)	36,176
“ “ (south side)	7,875
	44,051
Total square feet	127,832.35

The value of this remaining land must be over \$300,000.

RECEIVED FROM TIDE LANDS.

There has been received during the year, under Chap. 284 of the Acts of 1874, for land of the Commonwealth occupied by wharves or other structures in tide-water, the sum of \$27,484.82; and one or more licenses are pending, wherein the amount to be paid is not yet determined.

CHARLES RIVER BASIN.

In view of the various projects for encroachment upon Charles River Basin, and the fact that the harbor-line on the Cambridge side had been the subject of careful revision in 1878, it was deemed inexpedient to include that area in the re-statement of harbor-lines made last year. There are, however, many reasons why the policy which is to govern the treatment of this portion of the harbor should be definitely determined. The city of Boston has asked, and its application is now pending before the legislature, for a strip two hundred feet wide on the Boston side, extending from Cragie's Bridge to a point nearly opposite the junction of Brookline Avenue with Beacon Street, to be occupied for park purposes. The owners of flats on the Cambridge side desire to occupy to the present harbor-line for building purposes, and to enhance the value of their land within the line, by improving a strip outside the line two hundred feet wide for park purposes, in harmony with the plans of the Park Commissioners on the Boston side. Chap. 25 of the Resolves of 1878 gave certain powers to the Land Commissioners which plainly contemplated reclaiming a part of the Commonwealth's portion of the basin for sale as land. Every consideration affecting navigation, health, or the comfort and beauty of the locality, demands that so much of the basin as is not to be reclaimed should be deepened; and, that no work to this end may be wasted, it is important to know just what is to remain open. The area between West Boston Bridge and Brookline, which forms the upper basin, comprises about six hundred and forty-six acres; of which two hundred and forty-nine acres are the property of the Commonwealth, about three hundred and thirty-four acres belong to riparian owners on the Cambridge side, and the remaining sixty-three acres to private parties on the Boston

side. The average width opposite the Mill-Dam is about thirty-four hundred feet. If filling is permitted to the present harbor-lines and no encroachment permitted beyond those lines, the open basin will then contain about four hundred and thirty acres, or two-thirds the present area, of which the Commonwealth will still own two hundred and forty-nine acres, the riparian owners on the Cambridge side one hundred and fifty-five acres, and the riparian owners on the Boston side twenty-six acres. The basin would then be about twenty-three hundred feet wide, measuring opposite Fairfield Street.

All private ownership in the land covered by the basin, except in a few instances on the Boston side where rights to fill have already been granted, is subject to the public right of flowage by tide-water; and there is no obligation to relinquish this right of flowage save as the public interests may be served thereby. This is true of the area within the harbor-lines, as well as of the area without those lines.

Encroachment upon the area of tide-water, which could not be permitted for the purpose of promoting private gain, may sometimes be wisely allowed for public purposes, as for the promotion of the public health, or facilitating public travel. Gain to the public treasury is a public benefit which it is legitimate to weigh against public advantages surrendered. As a large expenditure of public money would be unwise to secure a small advantage to the harbor, so a large gain to the public treasury may be wisely secured by concessions which involve but slight disadvantage. To justify encroachment upon a natural provision for one public purpose, to secure another public object, it should, however, be very clear that the advantage to be secured outweighs the disadvantage involved; and all presumptions in case of doubt should be in favor of preserving natural advantages.

If the cost of converting a strip two hundred feet wide on the Boston side of the basin into a satisfactory park will equal the value of such park when constructed, then there is no gain to the public from such encroachment. Nearly one-half the sea-wall which would be required to retain the proposed embankment in the upper basin must be built in deep water, in the main channel, at large cost; and a considerable part of the filling occasioned would be in the deepest

part of the basin. Whether the money required to construct the embankment, even if the land were given, would not do more for park purposes in the purchase of land requiring less change to adapt it to such use, is a question for the city only, except so far as it may assist us to determine the importance of the public benefit to be secured by surrendering this portion of the basin for such use. It ought to be stated, that the portion in question is not now, or likely to become, a nuisance: nearly one-half of what lies in the upper basin is now deep water, and the remainder is that, the deepening of which will be most readily secured; while in the lower basin, all the area which it is proposed to occupy for the embankment is covered by a fair depth of water at all stages of the tide.

It would be difficult to estimate very closely what might be realized to the public treasury by reclaiming a portion of the Commonwealth's land on the Boston side of the basin for sale as land. The Board recognize that it is as incumbent upon them to study the property interest which the State has in the basin, as it is to ascertain the advantage or disadvantage to the harbor which may follow changes therein. If the reclamation of a single row of building-lots, extending from Arlington Street to the western end of the Mill-Dam, could be effected in connection with the park occupation, making the embankment perhaps three hundred and ten feet outside the present harbor-line instead of two hundred feet, it would not be unreasonable to anticipate a profit to the treasury of from seven hundred and fifty thousand dollars to one million dollars, according to the prices which should be obtained for the land sold. If the reclamation were made independent of co-operation by the city, sufficient land being filled for one row of lots, with a wide ornamented street in front, on the border of the basin, the profit would not be large; and in view of the depth of water, and the large cost of the sea-wall, it is not certain that such independent reclamation could be advantageously undertaken, aside from the question of its effect upon the harbor.

The filling which the riparian owners on the Cambridge side desire to make, is upon flats of which they own the fee. No grant of land is involved; but the surrender of the right of flowage might be as important to the public as a grant of

land, and cannot be made thoughtlessly. The authority to fill would hardly be granted, and probably would not be asked, without compensation in some form for the tide-water to be displaced. It is proposed that compensation be made by filling with material dredged from the basin. The material forming the bed of the basin is believed to be in large part equal to gravel from the country, and it is probably practicable to make the entire filling with dredged material; but, making some allowance for inequality of depths, which may be necessary to secure the required quantity of the best material, it is more prudent to estimate that only the amount of material needed to raise the reclaimed land to grade ten can be counted effective for securing a uniform depth in the basin. On this basis, if the Cambridge flats are reclaimed to the harbor-line, and no encroachment on the Boston side is permitted beyond the existing harbor-line, the bed of the basin remaining will be dredged to grade four below mean low water, thus giving at ordinary low water a minimum depth of four feet, and at low water of extreme spring tides a minimum depth of two feet, with considerable portions of the basin much deeper. This is probably sufficient to remove all danger to health, and all annoyance from offensive odors; and opportunity would be likely to occur from time to time to obtain other dredging. The Board would hope that a depth of twelve feet might be eventually obtained. No legislation is required to authorize filling to the harbor-line, as the general laws are sufficient; but the proprietors say that the proper development of their land will require the devotion of a part of it on the border of the basin to ornamental purposes, and that the cost of reclamation is so large, that the amount of land available for sale will not be sufficient to make it certain that their enterprise would result advantageously. They also say that a strip two hundred feet wide beyond the harbor-line can be enclosed with no increase of expense for the sea-wall, and that if they can be allowed to occupy such strip solely for park purposes, in harmony with the plans of the Park Commissioners on the Boston side, it would materially aid their enterprise. It would in no case be admissible to permit such occupation in the narrow neck of the basin, immediately below Brookline Bridge; but, if it were permitted from the point where

the space between the harbor-lines begins to widen materially to West Boston Bridge, the area of the basin which would then remain would be about three hundred and ninety-six acres, and the minimum depth of water would be increased about eighteen inches, making five feet six inches at ordinary low water. The park gained by such extension would have this advantage over that proposed on the Boston side, that it would be secured to the public with no expenditure of public money at the outset in its construction, and it would occupy what is now the shoal part of the basin, instead of what is the deepest. If this extension is granted, it will render much more objectionable that proposed on the Boston side. If the park embankment on the Boston side is permitted, and that on the Cambridge side refused, the area of the upper basin, which would then remain, would be about three hundred and ninety acres, and the minimum depth would be increased about two feet, giving six feet at ordinary low water. If both were permitted, the width of the basin would be reduced to nineteen hundred feet opposite Fairfield Street, its area to about three hundred and fifty-six acres, and its minimum depth increased to nearly eight feet at ordinary low water. It is of course assumed that no filling will be permitted unless dredging is required in connection with it.

The relative importance of the different public interests involved must be determined by the legislature; but on a careful study of the interests of the harbor, which it is the province of this Board to protect, it does not seem admissible to permit any encroachment upon the area of either basin beyond the present harbor-line, except as already provided by statute, to abate a nuisance at the abrupt angle in the line on the Boston side. If the desired deepening of the whole basin could be secured within a reasonable time, the Board would incline to preserve it intact; but it is not clear that this could be accomplished within the time which the public would be willing to endure the flats in their present condition. If the Board were re-stating the harbor-line on the Boston side, they would make a curve at one point where now there is an abrupt angle; but the only purpose of making such change is fully answered by Chap. 247 of the Acts of 1866, which permits the city of Boston to oc-

cupy in said angle to a curve therein described, and to appropriate the land so reclaimed for ornamental grounds or for a street, and otherwise they would advise no change in the line on either side.

The Board do not wish to exaggerate the effect upon the harbor to be anticipated from filling any part of these basins. It is easy to overstate the mischief that would follow, and it is quite possible that it has been overstated in the earlier discussion of the value and functions of the interior basins of Boston Harbor; but, after making all reasonable concession for over-statement and zeal on the part of advocates of special scientific theories, the sober judgment of all who are familiar with the discussion and with the experience in the important harbors of the Old World must be, that the value of these interior basins is very great, and their preservation very important. At no time in the history of Boston has the importance of its harbor to its future growth, and through its growth to the growth of the State, been more apparent than now. The magnitude of the foreign commerce which the country is certain to have, and the share of it which Boston may reasonably expect to obtain, is but just beginning to be outlined; but enough is already seen by all who have given the subject attention to make it clear that we cannot wisely be indifferent to any causes which may impair, in even a slight degree, the excellence of its harbor. The value of tidal reservoirs as aids in securing and maintaining the desired depth of water at points below such reservoirs is receiving increased attention in the ports of the world which are now making the largest expenditure to meet the demands of modern commerce; and there should be great caution in relinquishing any advantage which the harbor of Boston possesses in this direction. The basins of the Charles River are the most valuable of the reservoirs which remain. A large reservoir capacity at Prison Point Bay has been surrendered for the abatement of a nuisance to the public health, and it seems the more desirable to retain all of that which remains which it is possible to retain. The filling which may be authorized in the upper basin within the existing harbor-lines will reduce its capacity as a tidal reservoir 2,319,140 cubic yards; the strip which the Cambridge proprietors desire to improve outside the line, not continued into the neck of the basin, would

reduce it further 550,865 cubic yards; and the embankment desired by the Park Commissioners on the Boston side would effect a reduction of 643,000 cubic yards. It should be remembered that these quantities do not fully measure the loss, as the tide-water which lies at the highest plane here is the most effective in its work below, and the loss which will follow these encroachments, particularly upon the Cambridge side, is of tidal volume which lies at the higher plane, while the partial compensation made by dredging is of tidal volume at a lower plane. The obstructions of the outlet to these basins have seriously impaired the value of the reservoirs in question, and complicated the problem of their treatment; but it is not impossible that these obstructions may be much modified in the future, so that the power of the tidal flow may be more fully realized. It should increase the caution with which any portion of the interior reservoirs are given up, that the dredging in the harbor below has very much increased the area of channel depth to be maintained, and this will be still further increased in future. As the work which the flow of the tides is expected to perform is increased, there should be care taken that their volume is increased rather than diminished.

The proprietors on the Cambridge side desire that they may be authorized to build a bridge to the Boston side between the Brookline and West Boston Bridges. It is probable that a bridge at this locality will be required, and authority has once been given to the two cities to build one by Chap. 314 of the Acts of 1874; but this authority has expired. If it is thought wise to renew the authority, or to give it to other parties, or to allow this Board to do so, legislation would be necessary.

The opinion of Professor Henry L. Whiting upon the physical consequences of the proposed encroachments was sought by the Board in its study of the question; and his report will be found in the Appendix.

HARBOR-LINES AT EAST BOSTON.

The harbor-line at East Boston was established by Chap. 35 of the Acts of 1840, and from time to time parties were authorized to extend their wharves to the harbor-line. Prior to 1866 there was no Board to supervise the construction of

the wharves authorized, and each party ascertained the position of the harbor-line for himself. It has resulted that a number of wharves, now ancient, are in fact beyond the harbor-line; and some which the owners desire to extend to the line of the wharves upon either side of them cannot be so extended, because the harbor-line is in fact within the line which has been acted upon as the true line. The extensive plans for development of the more easterly part of the East Boston frontage which were known to be in progress led the Board to delay a re-statement of the line upon that side of the harbor, in connection with that established upon the frontage of the city proper by the Act of 1880. The Board are still unprepared to recommend a line for the whole frontage; but the difficulties which have recently come to their knowledge, in connection with the position of old wharves in relation to the existing line, has led them to consider whether it might not be wise to repeal the existing line, and leave that frontage without a harbor-line till the studies are ripe for a comprehensive treatment of the whole. The practical effect would not be as serious as formerly, as under existing laws licenses for structures may be given where there is no harbor-line; but, in lieu of the restriction of the established line, such licenses must have the approval of the Governor and Council.

The Boston and Albany Railroad Company desire to extend piers beyond the present harbor-line to a point in line with the other piers at their terminal grounds. Such extension would cross a channel by which wharves lying easterly are now approached; but the railroad company are willing to excavate a channel of equal capacity through the shoal lying outside, and the Board are advised by experts that the currents are not such at this point that any physical injury to the harbor would result from turning the channel as desired. The extension would furnish accommodation much needed, and the Board desire to grant it if upon full study there shall appear no insuperable obstacles. If the entire harbor-line at East Boston should be repealed, as above suggested, no other legislation would be requisite to permit this extension; but if the line should remain as now established, the Board recommend the passage of the bill for this purpose, given in the Appendix.

RE-SURVEY OF BOSTON UPPER HARBOR.

In addition to the points of triangulation determined by the work of Mr. Francis Blake, jun., of the United States Coast and Geodetic Survey, and given in a list of geographical positions, together with his report in the Appendix of the Report of the Board for 1875, a further determination by triangulation has been made, under the direction of the Board, by Mr. William E. McClintock, of the initial points in the harbor-line of so much of the frontage as has been included in the topographical survey. A list of these geographical positions will be found in the Appendix in the form heretofore presented, which is uniform with that adopted by the Coast Survey. All additional data for determining the relative positions of wharves in reference to the established harbor-line will be furnished, on application, from the archives of the Board.

COMPENSATION OF THE BOARD.

The members of the Board feel very strongly that the provision of law for their compensation is inadequate for the service which the position requires. With the consolidation of work formerly in charge of separate boards, the duties have ceased to be occasional, and demand daily attention from all the members. While it was not expected that the entire time should be given, it is found practically that there is very little time that can be given to private business which is not subject to frequent interruption from the necessary demands of the public work. If the *per diem* measure of the service was best while the work was in large degree experimental, it has ceased to be even approximately just. The time and character of service vary from attention to pure routine work for two or three hours, to the closest application to matters responsible and exhausting, continued through the entire day and late into the night. Whatever is deemed the proper compensation of the Board, it would seem more just and fitting that it should be measured by annual salaries. The questions with which the Board has to deal demand a quality of service that is entitled to liberal compensation. If they do not have this, it ought to be made possible to secure it. The aggregate transactions

of the Board are of sufficient pecuniary consequence to the Commonwealth to make it important that such service be had, as the indirect cost of inefficient service may be very large. It seems a plain duty to present these views for such action as may be thought proper: if sound, they concern the efficiency of the Board, and thus the interest of the Commonwealth, more than the personal interest of any member.

SPECIAL COMPENSATION.

The amount of special and exceptional work which was devolved upon the present Board during its first official year was so large, that it seems to the Board just that special provision should be made therefor.

A large amount of time was occupied in connection with hearings before referees upon the claim of Clapp and Ballou. The active demand for land upon the Back Bay which began in October, 1879, required close attention and much time from all the members. The sales amounted to \$556,652.35, and were effected entirely without the payment of commissions to brokers or auctioneers. Special duties with the Railroad Commissioners under Chap. 45 of the Resolves of 1879 also claimed considerable time. The more important special service growing out of negotiations relating to the land at South Boston, and the protracted hearing before the legislative committee arising out of one phase of those negotiations, involved a large amount of labor. Much of this work was professional in character, and all of it was responsible and exhausting. The hearing resulted in a sale under Chap. 260 of the Acts of 1880, amounting to \$1,108,165. There is no provision under which any allowance can be made for extra or professional service by members of the Board, nor would they suggest such provision for any moderate amount of such service; but the extent of that in question exceeds what can with justice to themselves be rendered without a request for compensation. It would seem to be in keeping with existing legislation to authorize the Governor and Council to allow such sum as should appear to them reasonable, subject to such limit as to amount as may be thought proper.

OFFICE AND FIELD WORK.

During the last year the operations of the Board connected with harbors and tide-waters have been in excess of those in any previous year. The number of licenses granted have also been larger than heretofore issued in one year. The demand for maritime facilities in Boston Harbor continues in about the same proportion with that in other harbors and coast localities; the applications for authority to build wharves and other structures in Boston Harbor being about one-fourth of the number presented. In connection with these improvements, the attention of the Board has been called to most of the harbors of the Commonwealth.

The following statistics, in the usual form, show the particulars of the work:—

Plans approved by the Board of Harbor and Land Commissioners during the Year 1880, for the Erection of Structures in and over Tide-water, and Licenses granted for such Structures.

Nos.

512. Kidder, Vaughan, & Co., for leave to construct a wharf in Chelsea Creek, East Boston. Approved Jan. 15, 1880.
513. Henry S. Sterling, for leave to extend his wharf at North Pocasset Buzzard's Bay. Approved Jan. 29, 1880.
514. Old Colony Railroad Company, for leave to widen its drawbridge and extend its draw-piers over Neponset River. Approved Feb. 5, 1880.
515. John C. Rhodes, for leave to construct a solid wharf at Mattapoisett. Approved Feb. 19, 1880.
516. George Curtis, for leave to straighten the line of his wharf in Roxbury Canal. Approved Feb. 27, 1880.
517. A Cochrane & Co., for leave to extend their wharf on Mystic River. Approved March 4, 1880.
518. William Rackliff, for leave to extend his wharf at "Oak's Cove," Gloucester Harbor. Approved March 18, 1880.
519. L. G. Burnham and others, for leave to build bridges across Dean's and Hog Island Rivers, in the town of Essex. Approved March 18, 1880.
520. Fitchburg Railroad Company, for leave to fill land and flats between its road and Eastern Railroad, in the city of Somerville. Approved March 18, 1880.
521. Boston and Albany Railroad, for leave to cover with a pile structure Dock No. 7, and extend Pier No. 7 of Grand Junction Wharves, East Boston. Approved March 25, 1880.
522. R. W. Bowles, for leave to construct a wharf at Mattapoisett. Approved April 29, 1880.

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Nos.

523. William Hale, for leave to extend his wharf on Merrimac River, Haverhill. Approved April 1, 1880.
524. Haverhill Steamboat Express Company, for leave to place a floating wharf on Merrimac River, near Salisbury Point. Approved April 7, 1880.
525. Edward P. Shaw, for leave to place a floating landing on Merrimac River, near Salisbury Point. Approved April 7, 1880.
526. New Bedford Yacht Club, for leave to construct a pile wharf near Pope's Island, New Bedford Harbor. Approved April 7, 1880.
527. George Perkins and William H. Perkins, jun, for leave to extend their wharves in Gloucester Harbor. Approved April 22, 1880.
528. Town of Dennis, for leave to construct a solid roadway across Sesuit Creek. Approved April 22, 1880.
529. Henry S. Sterling, for leave to extend his wharf at North Pocasset, Buzzard's Bay. Approved May 6, 1880.
530. Fitchburg Railroad Company, for leave to build an addition to its Miller's River freight-yard. Approved May 6, 1880.
531. Fitchburg Railroad Company, for leave to construct a bridge in Miller's River, to connect its freight-yard with Prison Point Bridge and Austin Street. Approved Sept. 4, 1880.
532. Horatio and J. A. Wellington, for leave to fill their dock west of Bridge Street, East Cambridge. Approved May 6, 1880.
533. Foster's Wharf Company, for leave to straighten the easterly side of its wharf on Fort Point Channel. Approved June 24, 1880.
534. City of Boston, for leave to rebuild a portion of Chelsea Bridge. Approved May 13, 1880.
535. Charles A. Ropes, for leave to extend his wharf on South River, Salem Harbor. Approved May 20, 1880.
536. James N. Buffum & Co., for leave to extend their wharf in Lynn Harbor. Approved May 20, 1880.
537. Robert Scott, for leave to drive piles to define the Commissioners' line on South Boston Point. Approved May 27, 1880.
538. Boston and Albany Railroad Company, for leave to construct an additional drawbridge over Broad Canal, East Cambridge. Approved June 9, 1880.
539. Fitchburg Railroad Company, for leave to fill land and flats in Miller's River, Charlestown District. Approved June 3, 1880.
540. Henry D. Baxter, for leave to construct a boat-pier at Hyannisport. Approved June 7, 1880.
541. Board of Health of the Town of Swampscott, for leave to extend its drains on Blaney's Beach, Swampscott. Approved June 10, 1880.
542. William F. Green & Son, for leave to extend their wharf on Border Street, East Boston. Approved June 10, 1880.
543. Charles L. Pearson, for leave to rebuild and extend his wharf on Fort Point Channel, Boston. Approved June 10, 1880.
544. Lynn and Boston Railroad Company, for leave to build a temporary bridge in Mystic River. Approved June 10, 1880.
545. M. A. H. Procter, for leave to build a wharf at Plum Island, Ipswich. Approved June 17, 1880.

Nos.

546. Thomas McKinney, for leave to build a wharf on the west side of Grape Island, Ipswich. Approved June 17, 1880.
547. City of Lynn, for leave to extend and enlarge the "Engine House" lot on Broad Street, Lynn. Approved June 17, 1880.
548. William C. Poland & Son, for leave to construct a wharf at Moon Island, Boston Harbor. Approved July 12, 1880.
549. Boston Tow Boat Company, for leave to build a pile pier at East Boston. Approved July 22, 1880.
550. City of Cambridge, for leave to build a pile structure across Charles River for the support of a water-pipe. Approved July 29, 1880.
551. Joseph F. Paul, for leave to fill solid part of his wharf near Doverstreet Bridge. Approved July 29, 1880.
552. Boston and Albany Railroad Company, for leave to widen Pier No. 7, and deepen Dock No. 8, Grand Junction Wharves, East Boston. Approved July 29, 1880.
553. City of Haverhill, for leave to improve the draw-ways of Rock's and Groveland Bridges across Merrimac River. Approved July 29, 1880.
554. Lynn and Boston Railroad Company, for leave to build a temporary bridge in Mystic River, north of north draw of Chelsea Bridge. Approved July 22, 1880.
555. New York and New England Railroad Company, for leave to build a platform in the Boston and Albany Railroad Company's Dock at South Boston. Approved Aug. 5, 1880.
556. City of Chelsea, for leave to rebuild its part of Chelsea Bridge. Approved Aug. 12, 1880.
557. Eastern Railroad Company, for leave to fill solid Mill Creek Bridge on the line of its road in Essex. Approved Aug. 12, 1880.
558. Pasque Island Corporation, for leave to construct a wharf at Pasque Island, town of Gosnold. Approved Aug. 19, 1880.
559. Gosnold Mills Corporation, for leave to extend its wharf in New Bedford Harbor. Approved Aug. 26, 1880.
560. Eastern Railroad Company, for leave to fill solid its main track between Austin Street and the crossing of the Fitchburg Railroad, Charlestown District. Approved Sept. 2, 1880.
561. Hull and Nantasket Beach Railroad, for leave to construct its road across tide-water in the town of Hull. Approved Sept. 16, 1880.
562. City of Boston, for leave to construct a temporary dam in South Bay. Approved Sept. 16, 1880.
563. Mary J. Healey, for leave to construct a pile wharf in Dorchester Bay. Approved Sept. 16, 1880.
564. Washington Allen, for leave to build a stone pier on Scraggy Neck in Sandwich. Approved Oct. 12, 1880.
565. Edward P. Shaw, for leave to place a floating landing on Merrimac River, near Salisbury Point. Approved Sept. 23, 1880.
566. Butchers' Slaughtering and Melting Association, for leave to build a sea-wall and fill flats on Charles River, Brighton District. Approved Sept. 30, 1880.
567. Proprietors of Tide Meadows in the town of Salisbury, for leave to

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Nos.

- fill solid two bridges on the line of the Eastern Railroad. Approved Sept. 30, 1880.
568. John Gary and the heirs of John Wesson and Abel Fitz, for leave to extend Tuft's Wharf on Charles River, Charlestown District. Approved Nov. 4, 1880.
569. Francis E. Foster, for leave to re-construct his wharf on Mystic River, Medford. Approved Oct. 8, 1880.
570. Salem and Magnolia Steamboat Company, for leave to construct a wharf on Salem Neck, Salem Harbor. Approved Oct. 8, 1880.
571. Salem Bay Yacht Club, for leave to construct a wharf on Salem Neck, Salem Harbor. Approved Oct. 8, 1880.
572. Standard Sugar Refinery, for leave to extend its wharf on Fort Point Channel, South Boston. Approved Nov. 11, 1880.
573. Revere Beach Land Company, for leave to construct a bulkhead, and fill the area enclosed by the same near Cherry Island Bar, Revere. Approved Nov. 18, 1880.
574. Fitchburg Railroad Company, for leave to extend its wharf on Charles River, Charlestown District. Approved Nov. 27, 1880.
575. Boston and Albany Railroad Company, for leave to extend its Dock No. 3, Grand Junction Wharves, East Boston. Approved Dec. 9, 1880.
576. Benjamin Low, for leave to extend his wharf in Gloucester Harbor. Approved Dec. 9, 1880.
577. Thomas B. Tripp, for leave to construct a wharf in Clark's Cove. Approved Dec. 16, 1880.
578. Andrew W. Dodd, for leave to extend wharf in "Vincent Cove," Gloucester Harbor. Approved Dec. 23, 1880.
579. Benjamin F. Cook, for leave to extend his wharf in "Vincent Cove," Gloucester Harbor. Approved Dec. 23, 1880.
580. Heirs of William Collins, for leave to extend their wharf in "Vincent Cove," Gloucester Harbor. Approved Dec. 23, 1880.
581. Chresten Nelson, for leave to extend his wharf in "Vincent Cove," Gloucester Harbor. Approved Dec. 23, 1880.
582. Ellerton L. Dorr, for leave to construct a wharf on Peters Neck, town of Wareham. Approved Dec. 23, 1880.
583. George Peabody, for leave to extend Fiske's Wharf to harbor line, Boston Harbor. Approved Dec. 31, 1880.
584. John McKinnon, for leave to build a wharf on Belle Isle Creek, East Boston. Approved Dec. 31, 1880.
585. Pacific Guano Company, for leave to extend its wharves at Woods Holl, Town of Falmouth. Approved Dec. 31, 1880.
586. Boston and Albany Railroad Company, for leave to rebuild sea-wall in Dock No. 6, Grand Junction Wharves, East Boston. Approved Dec. 31, 1880.

HARBOR IMPROVEMENTS BY THE GENERAL GOVERNMENT.

The work of the General Government in the harbors and rivers of the Commonwealth during the year have been of unusual interest and importance. That in the section north of Cape Cod has been in charge of Gen. Thom, and that in the section south of Cape Cod in charge of Gen. Warren. These officers have at the request of the Board kindly furnished detailed accounts of the operations in their charge, which will be found in the Appendix, and to which attention is called.

The great improvements which have been accomplished under the liberal policy of the General Government, not alone in Boston Harbor, but in the rivers and smaller harbors of the Commonwealth, cannot fail to have a marked effect upon the prosperity of the State. The projected works on the Merrimac and Charles Rivers at Nantucket, Woods Holl, and Wareham, are worthy of attention and encouragement on the part of the State.

The plan of opening the Connecticut River for navigation, with a depth of eight feet to Holyoke, and the possible extension of navigation still further up the river, deals with what is not tide-water, nor yet a harbor, but the Board venture to commend the measure as one of much practical importance to the Commonwealth.

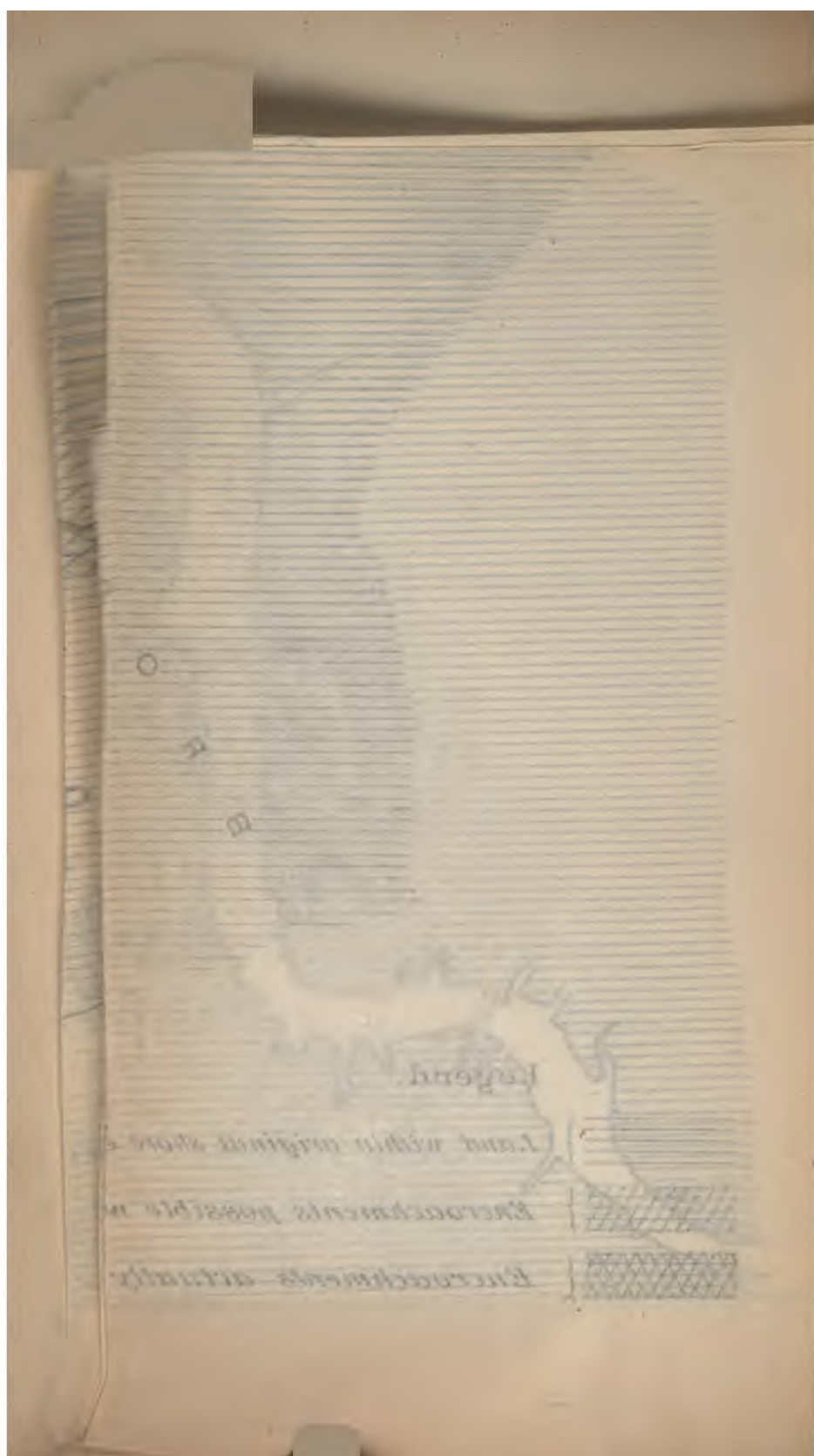
The people of Edgartown have been with good cause much interested in the consequences to their harbor from the closing of the inlet through Cotamy Beach, and are moving to secure the renewal of efforts by the General Government to re-open this inlet. The Board desire to second heartily this movement, and will co-operate with the efforts being made to secure the favorable action of Congress.

ALBERT MASON.
WILLARD P. PHILLIPS.
FRANCIS A. NYE.

BOSTON, Jan. 1, 1881.



INTING G. BOSTON.



APPENDIX.

APPENDIX.

[A.]

PHYSICAL CONSEQUENCES OF ENCROACHMENT UPON CHARLES RIVER BASIN.

IN discussing the subject, as above defined, it can be more systematically treated by considering the two geographical sections separately: namely, the water-space between Brookline and West Boston Bridges, which will be called, for the purpose of distinction, the Upper Basin; and the water-space between West Boston and Cragie Bridge, which will be called the Lower Basin.

The natural and physical conditions of these basins are also of distinctive character.

The Upper Basin is a shallow water, with large areas of flats, dry at low tide, occupying much of its space, and through which a comparatively narrow channel of unequal depth and width forces its way.

The Lower Basin is of smaller area, with its channel portion comparatively larger, deeper, and more regular in form. The more contracted natural water-way between the firmer shores of the north end of the city proper and East Cambridge have formed a deeper channel, which continues this general character through the lower sections of the river to its confluence with Chelsea Creek and the Mystic; and in its original natural state was one of the deepest, if not the very deepest, section of the arms of the inner harbor, and still so remains.

The value of these interior basins, as reservoirs, has been much affected by the obstructions which, from time to time, have been allowed to encumber the outlet of the river; and the treatment of them, as factors in the conservation of the main harbor, made difficult and uncertain.

In the Ninth Report of the United States Advisory Council for Boston Harbor, pp. 11, 12, they say, "In the case of Charles River and its adjacent basins, the bridges offer at present too much obstruction to make a full reduction of flats and marshes serviceable. When the bridges which now encumber the mouth of Charles River and distort its bed are improved by the introduction of such systematic and uniform constructions as will increase the water-ways, and correct the present disorderly flow of the stream, it will be practicable to enlarge the tidal prisms here

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described (of the basins above). In the existing state of things, we do not advise any excavations below the half-tide plane."

Much as it may be desired to improve constructions, and more particularly to remove obstructions, no precedent in the history of our legislation applicable to such cases can be found of acts effecting restoration of water-ways and water-spaces, or the removal of encroachments upon them, although frequently done elsewhere. It seems, therefore, only practicable to consider conditions as they are, and to deal with difficulties as they exist, and to so study and prescribe the better modes of change and adaptation to what may be the necessary demands of commerce and requirements consequent upon the steadily increasing proportions and importance of the port and city.

In the scheme of revised harbor-lines for the basins of Charles River, which was recommended by the Board, a careful study was made of the adjustments of filling and excavation, and a system of lines devised which left the tidal prism of these basins intact. The details of this plan were stated in the Seventh Annual Report of the Harbor Commissioners for 1873.

Upon the petition of riparian proprietors on the Cambridge side of the Upper Basin, the lines established in 1873 were changed by subsequent legislation (Chap. 77 of 1878), and a harbor-line established on the Cambridge side of the basin, which lessened its reserved water-area by about sixty acres, and its tidal prism by about 885,304 cubic yards. A statement of particulars in regard to the changes which were subsequently effected was made in the Annual Report of the Harbor Commissioners for 1877.

On Aug. 30, 1872, licenses were granted under Chap. 236 of the Acts of 1872 to George Griggs and others, Edward Atkinson and others, and to the Boston and Roxbury Mill Corporation, to build a sea-wall and fill solid behind the same on the southerly side of the Upper Basin out to the harbor-line. A detailed statement concerning this matter was given in the Seventh Annual Report of the Harbor Commissioners (1873). Work has been done in substantially carrying out the plans proposed, although it is not yet completed.

In the Lower Basin no change has been made in the harbor-lines as they existed at the time of the studies by the United States Advisory Council.

On July 8, 1874, the Board granted a license to James A. Woodbury and others, whose interests were afterwards merged in the Cambridge Improvement Company, to fill flats on the Cambridge side of the Lower Basin within the harbor-line. This contemplated the occupation of a large area, about fifty-five acres, and the displacement of about 802,080 cubic yards of tidal prism. The arguments and conditions of the license granted were stated in the Ninth Annual Report of the Harbor Commissioners for 1875. The operations of this company have been suspended, although something has been done in partially carrying out the original plans of filling and excavation; but, as the work is in an unfinished state, no surveys have been made by which its present condition can be ascertained with precision.

In the changes made in the basins of Miller's River and Prison Point Bay, the loss of reservoir capacity, or tidal prism, is much in excess of any compensating excavation; in fact, but little dredging has been done excepting some minor work in what remains of Miller's River. Compensation in money has been paid for a part of the tide-water displaced, but at a merely nominal price; the total amount received by the Commonwealth for the loss of these reservoirs being \$11,620 (?). If their full value had been paid, as estimated by the Advisory Council at the cost of compensation in kind, the amount would have been \$520,000.

A statement was made, in full detail, of the history of the disposition of those basins, in the Annual Report of the Board for 1877, from which the following extract is made:—

“Of the original bay, which comprised 64.8 acres, subject to the fourth section of the law of 1866 establishing the Board of Harbor Commissioners, 12.8 acres have been filled; there now remain unfilled 52 acres. Of the 12.8 acres filled, 7.3 acres have been reclaimed without authority; and of the 52 acres still unfilled, 29 acres have been licensed subject to compensation for tide-water displaced; so that there remain only 23 acres of tide-water, over which the Commonwealth retains any jurisdiction in the interest of harbor preservation.”

The following is a tabular statement of the data which have formed the subject of the preceding remarks:—

DESIGNATION.	ACT OF LEGISLATURE.		LICENSE OF BOARD.		AREA.		Depth of Tide.	Volume to be Displaced.	AREA ACTUALLY FILLED.		Volume actually Displaced.	Volume for which Compensation has been received.
	Chapter.	Year.	No.	Year.	Square ft.	Acres.			Square ft.	Acres.		
Eastern and Fitchburg Railroads, jointly	335	1867	21	1868	632,400	14.5	8.6	201,764	26,750	0.6	8,520	None.
City of Charlestown	253	1868	None.	None.	82,200	1.9	4.0	12,107	82,200	1.9	12,107	12,107
Encroachment by private parties inside Canal Street	None.	None.	None.	None.	-	-	3.9	-	159,709	3.7	23,069	None.
Encroachment by private parties outside Canal Street	None.	None.	None.	None.	-	-	6.8	-	66,500	1.5	16,746	None.
Encroachment by Commonwealth in vicinity of State Prison .	None.	None.	None.	None.	-	-	4.0	-	79,107	1.8	11,720	None.
Boston and Maine Railroad .	None.	None.	None.	None.	-	-	7.0	-	13,500	0.3	3,500	None.
Eastern Railroad	{ 360 45	{ 1873 1874	{ 207 391	{ 1874 1877	787,565	18.1	8.1	236,269	129,636	3.0	38,891	- None.

NOTE. — The above table represents the measure of quantities as they were at the time it was compiled, — January, 1878.

From as close a measurement and estimation as our data afford, some of which is not precise, the loss of reservoir capacity, or tidal prism, in the two basins of Prison Point Bay and Miller's River, amounts to about 1,384,600 cubic yards.

As the judgment and estimates of the Advisory Council were based upon the combined active functions of all the inner basins of Charles River, the loss of so much of those of Prison Point Bay and Miller's River makes it still more important to retain all the tidal power they yet possess in the remaining basins.

In the report of the Advisory Council, before referred to, the tidal prism of the inner basins of Charles River are given as follows:—

	CUBIC YARDS.
Between Brookline and West Boston Bridges . . .	9,259,900
Between West Boston and Cragie Bridges . . .	2,082,500
Prison Point Bay and Miller's River . . .	1,846,215
	13,188,615

The loss of tidal prism in these basins since the report of the Advisory Council including the contemplated displacement of tide-water by the harbor-lines of 1878 in the Upper Basin, and the fillings authorized on the part of the Cambridge Improvement Company in the Lower Basin, we have the following result:—

	CUBIC YARDS.
In the Upper Basin	885,304
In the Lower Basin	802,080
In Miller's River and Prison Point Bay	1,384,600
	3,071,984

About 22 per centum of the original tidal prism.

In comparing the amount of obstruction to the outlet of these basins in 1861, with that of the present date, — 1880, — those structures only are mentioned in which substantial change has been made.

In the report of the Advisory Council the areas of the bridges crossing the mouth of Charles River are given as follows, to which is added the areas of the same bridges at the present time in a separate column:—

	1861.	1880.
	Square feet.	Square feet.
Warren and Fitchburg	272,900	389,890
Boston and Maine Railroad	216,750	284,390
Lowell and Eastern Railroad	128,740	249,770
Lowell Freight	83,300	112,900
Cragie	74,500	81,110
	776,190	1,117,060

About 50 per centum of *increase* from original area.

In an able report prepared by Gen. J. G. Foster in the spring of 1869, at the time the subject of widening and improving the draw-way openings

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through the bridges crossing Charles River was under consideration, and while he was in charge of the government improvements being made in the lower harbor, he prepared a table of statistics, showing the extent and amount of obstruction to the free flow of the tide caused by those bridge structures, and from which the following items have been taken. Gen. Foster sent his own men, in boats, under the bridges, and had the piles in each bridge actually counted, and sketches made showing the irregular and injurious manner in which the piles were placed in the various structures.

	Number of Piles in each Bridge.	Mean height of Piles f'm bottom to high water.	Mean ob- struction offered by Piles.	Total water- space remain- ing after deducting the obstruction of Piles.
		Feet.	Square feet.	Square feet.
Charles River Bridge . . .	486	27	1,200	25,401
Warren Bridge	771	26	1,637	26,953
Fitchburg R.R. Bridge . . .	3,265	26	68,565	18,215
Boston and Maine R.R. Bridge .	3,754	24	72,077	17,477
Eastern R.R. Bridge	1,022	24½	20,031	
Lowell R.R. Bridge	672	24½	13,171	
Lowell Freight Bridge . . .	756	24	14,515	34,435
Cragie Bridge	663	23	12,199	24,151
Total	11,389		203,395	

In the case of the Fitchburg Railroad bridge, the most objectionable structure, the striking condition is exhibited of a mass of obstruction amounting to 72,077 square feet with 17,477 square feet of free water-space; the obstruction being about four hundred per centum of the room left for free flowage.

As will be seen by looking at the maps, the bridges forming the most obstruction are in such close proximity and so grouped together as to form almost a continuous resistance to the flowage. These are the Warren and Fitchburg, in part one structure, the Boston and Maine, and the Eastern and Lowell passenger, also nearly a united structure. So that it may be said, that substantially these bridge structures, in 1869, contained 9,484 piles, each pile averaging a length of 25 feet within the water, and presenting the startling amount of 175,481 square feet of submerged surface; so disposed, both in rows and singly, that almost every pile presented an abrupt obstruction to the current. Allowing for the same ratio of increase in the piling as in the surface area of the bridges, there would be, at the present time, about 16,400 piles, and about 303,400 square feet of surface obstruction.

Although the piles which have been driven under the direction of the Board have been in lines which coincide with the direction of the current, so that when all the piles under all the bridges shall have been made to conform to the same order, the flowage will be improved, the disorderly manner in which the old piling still remains so shuts up the bays that no material gain is yet effected.

From the above statements it is evident that no improvement or relief to the outlet of the inner basin of Charles River has been effected since the criticism of their usefulness as tidal reservoirs was made by the able engineers who gave so much study and investigation to this subject.

It shows, however, the serious consequences and great misfortune of giving away, little by little, to encroachments, which, at the time, are made to appear insignificant in their physical disadvantage, while all important to other purposes they are proposed to serve, until, by persistent appeals for legislation, grants are obtained for which no commensurate equivalent is, or can be, given.

Already one of the choice portions of the inner harbor of Boston is lost to maritime commerce by the net-work of bridges that cross its deepest water; unless it be not too late to reconstruct with a more wise adjustment of terminal facilities, of which Boston, as one of the few great ports of our Atlantic coast, stands so much in need. No part of the inner harbor affords more inducement to improvement than the lower portion of Charles River, from the Navy Yard to Cragie Bridge. The Advisory Council calls attention to it on physical grounds, and a comprehensive study of its capabilities will develop many other reasons for improvement.

Independent of physical considerations, the improved appliances of machinery and modes of dredging give the question of excavation a significance different from that of the earlier periods when it was less effectively and systematically managed, and when the inner reservoirs and outer channels of the harbor had more unobstructed avenues, by which to maintain their connections and exercise their mutual functions.

The subject of harbor conservation and improvement presents, to-day, more complicated features, and those which bring to bear upon it the results of experience and knowledge in the more modern modes of treatment.

In the licenses granted by the Board for the works in the upper basins of Charles River, the question of improved navigation was considered of so much importance, that it entered largely into the scheme of compensation. To further improve these basins by dredging them to a greater uniform depth, say ten or twelve feet at mean low water, would be a work of great value.

Such deepening, with the filling of all border-lands, would also be a sanitary work of the first order. It has been found, by experiment, in France, that the sanitary influence of waters which covered lands or marshes otherwise unhealthy, or into which sewage or other foul matter found its way, was in proportion to its depth; that a film of water, although constantly maintained, did not prevent miasmatic exhalations, whereas *deep water* absorbed the noxious vapors, or was so far effective that the shores and grounds bordering upon them were rarely unhealthy.

The æsthetic question, in the treatment of these basins, is hardly less important, and has received a public and individual attention which entitles it to high consideration; while nothing that is likely to be done in this direction will injure the navigable value of the basins, or impair their sanitary influence.

The purpose and occasion of the present study and investigation of this subject is a demand for land upon the borders of the Charles River basins which it is proposed to obtain by encroachments upon their water-spaces; and the discussion of facts and theories in regard to them has been made in the hope of leading the way to some wise solution of the problem under consideration.

In the plans proposed by the Park Commissioners and other parties, various lines have been suggested. Three definite ones, however, have been named by the Board for special consideration, — two in the Upper Basin and one in the Lower Basin.

The first in order is a line in the Upper Basin, beginning at some point in the present harbor-line near the westerly end of the Mill-Dam, and running easterly parallel to and 200 feet advanced from the Mill-Dam, turning the south-easterly corner of the basin by a suitable curve, and running northerly parallel to the easterly line of the basin, and terminating at a point on the West Boston Bridge, 200 feet westerly from the present sea-wall.

Such a general line will take from the basin area about . . .	1,602,400 sq. ft.
Equal to about	36½ acres.
And will reduce the tidal prism	930,100 cu. yds.
The amount of filling required to raise this area to grade	
ten	978,279 cu. yds.

The second line in order is one following the same general course, and terminating at the same point on the West Boston Bridge, but being advanced substantially 300 feet into the basin.

Such a general line will take from the basin area about . . .	2,313,500 sq. ft.
Equal to about	53½ acres.
And will reduce the tidal prism	1,277,920 cu. yds.
The amount of filling required to raise this area to grade	
ten	1,326,147 cu. yds.
The encroachment upon the Lower Basin by following the	
line proposed by the Park Commissioners, which runs	
from a point near the easterly abutment of Cragie Bridge	
in a generally straight course to the same point named in	
West Boston Bridge, 200 feet from the sea-wall, is about . . .	200,800 sq. ft.
Equal to about	4½ acres.
And will reduce the tidal prism about	74,370 cu. yds.
The amount of filling required to raise this area to grade	
ten, about	109,090 cu. yds.

A further project has been brought forward to improve the opposite Cambridge shores of the Upper Basin; and a belt of 200 feet, to be taken from the basin beyond the harbor-line, is asked for as a part of the proposed plan.

Such a line, 200 feet beyond the harbor-line, will take from	
the basin area about	1,650,400 sq. ft.
Equal to about	37½ acres.
And will reduce the tidal prism about	550,865 cu. yds.
The amount of filling required to raise this area to grade ten	
will be about the same	550,865 cu. yds.

A project looking to the improvement of the Cambridge shores, in connection with the improvement proposed upon the Boston side, is much to be desired; but there seems to be no adequate necessity for making land from the basin area on the Cambridge side, and no exigency to warrant an additional encroachment upon it from this direction to that which has been already made by the advanced harbor-line of 1878. The lands adjoining are in an unimproved and undeveloped state, open to other schemes of treatment. Upon the Boston side, where heavy sea-walls and expensive structures already occupy the immediate shores of the basin, it is more difficult to operate without taking some territory from the basin.

It would seem a more wise and practicable project to appropriate the marginal ground of the entire basin to park purposes, and to treat the subject of the improvement of this splendid basin as a unit.

To devote a certain margin to the æsthetic and healthful purposes of a park, and at the same time secure the establishment of *permanent boundary lines*, would have much to recommend it; but no concession should be made for private purposes, and the least amount of encroachment only allowed which will serve for public use.

That some reduction of the tidal prism of these basins may be permitted in consequence of the increased obstruction to their outflow, is possible; but to what extent can only be determined definitely after special examination and field observations similar in character to those which were the bases of the judgment of the Advisory Council. Such observations it has not been practicable to make since the questions under consideration have been presented. Without such data it would be unwise to prescribe changes in the physical status of the tidal forces, even as an offset to increased obstructions, large as they appear to be, which may produce results that cannot be predicted. As stated in a former report concerning the changes in the harbor-line of 1878, any scheme other than one looking to tidal compensation must be considered as arbitrary.

The Advisory Council did not recommend excavation in the upper basins of Charles River below the half-tide plane; but as there are only small portions of these basins near the upland line of the Cambridge shore, where the surface of the flats came above this plane, this rather negative caution on the part of the council goes to establish the theory that any material change in their present status is undesirable.

Assuming that two hundred feet of advance on the Boston side of the upper basin, and the line proposed by the Park Commissioners in the Lower Basin, will accomplish all that may be desirable, the remaining condition of these basins will be about as follows: —

Area of basins about	17,334,500 sq. ft.
Equal to about	398 acres.
Loss of tidal prism about	6,420,196 cu. yds.
Amount of excavation to deepen the basins to 12 feet below mean low water	5,825,350 cu. yds.
Amount of space inside of the stated lines as territory to be filled by the material removed from the bed of the basin up to say grade ten, is about	1,411,350 cu. yds.

While it is the logical inference that it is *not* desirable to *increase* the

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reservoir capacity of the Charles River basins, it does not follow that it is desirable, or even permissible, to *reduce* them.

The basins, treated independently of the consequences to the harbor elsewhere, should remain as large in area as consistent with securing the desired depth. Their full utilization for navigation, also sanitary and æsthetic considerations, all require that the depth of water should be increased. To the extent necessary to secure a desired uniform depth in the area which may remain, a contraction of area may be permitted. This is not necessarily to permit just that area to be filled which will contain the material which it is requisite to remove, but rather that the privilege of filling which will constitute sufficient inducement to perform the necessary excavation.

The improvement of these basins ought not to be at the cost of the Commonwealth; but, on the other hand, if they can be so improved that great public benefits are conferred in their better adaptation to business and pleasure navigation, and in their sanitary and æsthetic effect on the community in which they are located, it is not essential that pecuniary profit should be derived by the Commonwealth from the improvement. If, when the public concedes some considerations of advantage, it secures other public considerations of greater moment, the gain is in even safer form than if committed into a money profit less permanent in its effects.

Great importance should be attached to the devotion of as much of the area as shall be reclaimed from the Charles River basins to *public purposes* as is practicable; not, of course, because of the effects upon the harbor below, but upon the broader grounds which any intelligent study of the question necessarily introduces. The harbor-line upon the Cambridge side, as already established, is a large concession to the owners of flats, and any further extension should be granted with great caution. The appropriation of a belt two hundred feet wide on that side to public purposes is very desirable; and, if it cannot be obtained within the present harbor-line, it may be expedient to make some further concession. But, if this should be done, it would be more difficult to permit the three hundred feet, or even the two hundred feet, extension upon the Boston side.

Respectfully submitted.

HENRY L. WHITING.

To the Board of Harbor and Land Commissioners.

[B.]

RE-SURVEY OF BOSTON UPPER HARBOR.

[C.]

CONTRACT WITH THOMAS POTTER.

Articles of Agreement made this twenty-eighth day of August, in the year eighteen hundred and eighty, by and between THOMAS POTTER, of Jersey City, in the State of New Jersey, party of the first part, and the COMMONWEALTH OF MASSACHUSETTS, acting by its Board of Harbor and Land Commissioners, party of the second part, witness:—

The said party of the first part hereby covenants and agrees with said party of the second part, to dredge three hundred thousand cubic yards of material from the shoals, in that part of Boston Harbor represented by the space colored red on the plan hereto annexed, at places to be designated by the engineer of the Board of Harbor and Land Commissioners, and to deposit said dredged material on the flats of said Commonwealth, lying east of and adjoining the flats bargained to the Boston and Albany Railroad Company, and between the southerly line of Eastern Avenue or Congress Street extended, and the northerly line of occupation as indicated on said plan, at such places and in such order as the engineer of said Board shall designate. It is agreed that all said dredging shall be to a depth of twenty-three feet at mean low water, and that the bottom of the whole area dredged over is to be left smooth and regular at that depth to the satisfaction of the engineer of said Board, and that the amount of excavation shall be determined by measurement of the filling when deposited as herein provided, the present surface as shown on a plan of even date herewith made in duplicate and entitled "Plan of Filling at South Boston Flats for the Commonwealth," and signed by said party of the first part, and by said Board, to be used as the basis of such measurement.

All said filling shall be made from the present surface to grade thirteen, and shall be left smooth and level at said grade thirteen, and where the boundaries of said filling are protected by other filling, or by wall or bulkhead, the filling shall be brought up to grade thirteen at such boundaries; but where the boundaries are unprotected the material may be allowed to take its natural slope. In filling immediately behind a wall or bulkhead the material shall be deposited in such a manner that it will flow away from the wall or bulkhead, and not towards it. The lines, grades, and instructions given by the engineer of said Board, shall be strictly observed, and all necessary aid and materials for giving said lines and grades shall be furnished by said party of the first part. The dredging and filling aforesaid shall be commenced within three months after the execution and delivery of this agreement, and shall be prosecuted

continuously during all suitable weather, and with as much despatch as reasonably practicable until its completion; and shall be completed on or before the first day of January, in the year eighteen hundred and eighty-three.

The said party of the second part hereby covenants and agrees with said party of the first part, to pay said party of the first part for said dredging and filling at the rate of thirty-six cents per cubic yard, in the manner, and upon the terms and conditions, herein set forth and agreed, as follows:—

Monthly estimates of the work executed will be made by the engineer of said Board, and for all the material deposited directly from the scows, a payment of seventy-five per cent of the contract-price will be made; and for all material deposited from cars, a payment of ninety per cent of the contract-price will be made; and when said filling is completed to grade seven upon any portion of said area to be filled, for the material deposited on the area so raised to grade seven such further payment shall be made as will make the entire payment therefor equal to ninety per cent of the contract-price; and upon the entire completion of all said dredging and filling, in the manner and within the time herein agreed, the remainder of said contract-price shall be paid.

It is agreed, by and between the parties hereto, that upon all questions of measurement, lines, or grades, the decision of the engineer of said Board shall be final.

It is further agreed, by and between said parties hereto, that should the party of the first part refuse or neglect to prosecute the work herein contracted for, with the requisite vigor to insure its completion within the time herein stipulated, or in any other respect violate this agreement, the said Board shall have power to annul this agreement, and to contract anew with other parties.

In testimony whereof, the said Thomas Potter has hereunto set his hand and seal, and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered, in its name and behalf, by its Board of Harbor and Land Commissioners, the day and year above written, and the same to be approved by its Governor and Council.

THOMAS POTTER. [SEAL.]
COMMONWEALTH OF MASSACHUSETTS,

[SEAL OF THE
COMMONWEALTH.]

By ALBERT MASON,
WILLD. P. PHILLIPS,
FRANCIS A. NYE,
Harbor and Land Commissioners.

IN COUNCIL, Aug. 31, 1880.

Approved.

HENRY B. PEIRCE, *Secretary.*

[D.]

BILL RECOMMENDED.

Commonwealth of Massachusetts.

AN ACT TO AUTHORIZE THE CONSTRUCTION OR EXTENSION OF
WHARVES IN BOSTON.

Be it enacted, &c., &c.

That the Harbor and Land Commissioners shall be, and hereby are, authorized to permit the construction or extension of wharves in that part of Boston called East Boston, easterly of Pier No. 4, so called, of the Boston and Albany Railroad Company, to such line as they shall prescribe, and in such manner, and on such terms and conditions in other respects, as are now allowed by law, or shall be prescribed by them.

[E.]

STATEMENT OF OPERATIONS DURING THE YEAR ENDING DEC. 31, 1880, ON WORKS FOR THE IMPROVEMENT OF RIVERS AND HARBORS IN THE STATE OF MASSACHUSETTS, UNDER THE CHARGE OF BREV. BRIG.-GEN. GEORGE THOM, COLONEL OF ENGINEERS.

I.—IMPROVEMENT OF BOSTON HARBOR, MASSACHUSETTS.

The following operations for the improvement of this harbor by the United States Government have been carried on during the year ending Dec. 31, 1880, to wit:—

1. Under a contract made Aug. 15, 1878, with Mr. Joseph E. Bartlett of Boston, Mass., for the removal, by dredging, of the Man-of-War Shoal (situated in the upper harbor, at the confluence of Charles and Mystic Rivers), to a depth of 23 feet at mean low water, dredging operations, commenced by him in the latter part of 1878, were continued until the 12th of March, 1880, resulting in an aggregate of about 86,000 cubic yards, in completion of said contract; of which dredging about 6,000 cubic yards was done subsequent to the 1st of January. By these operations this shoal has been reduced on an area of about 55,000 square yards to the projected depth of 23 feet at mean low water, on the shoalest part of which the depth was formerly but 15½ feet. This work was done in a very satisfactory manner, and under difficulties, for which the contractor is entitled to much credit.

2. On the 28th of August, 1879, a contract was made with the New England Dredging Company, of Boston, Mass., for—

(a) 38,000 cubic yards, more or less, of dredging at Anchorage Shoal, for obtaining a depth of 23 feet at mean low water, at 74 cents per cubic yard, *measured in situ*; and

(b) 6,000 cubic yards, more or less, of dredging at the Lower Middle Shoal, to the same depth as above, at 84 cents per cubic yard, *measured in situ*.

Operations were commenced under this contract at Anchorage Shoal on the 15th of September, 1879, and were continued up to the 17th of December, when they were suspended for the winter. They were resumed on the 19th of April, and, after some interruptions by the dredging at the Lower Middle, were completed on the 22d of September, 1880, resulting in an aggregate of 27,556 cubic yards of dredging (*in situ*) under and in completion of said contract; of which 17,619 cubic yards has been done during the past year. By these operations the main ship-channel has been opened on an area of about 48,600 square yards, to a depth of 23 feet at mean low water, for a width of about 550 feet.

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At the Lower Middle Shoal dredging was commenced, under this contract, on the 14th of June, and continued until the 15th of August, 1880, during which period 5,007 cubic yards of dredging (*in situ*) was done, on an area of about 17,500 square yards, in completion of said contract. By these operations the main ship-channel has been widened and deepened so as to have, for a width of 600 feet, a depth of 23 feet at mean low water.

3. On the 11th of September, 1879, a contract was made with the New England Dredging Company—the lowest of four bidders, after proposals had been twice invited for the work—for 50,000 cubic yards, more or less, of dredging in Mystic River, near its mouth, at 33 cents per cubic yard, *as measured in scows*. Operations were commenced under this contract on the 2d of October, 1879, and continued up to the 15th of March, 1880, resulting in an aggregate of 47,953 cubic yards of dredging on an area of about 25,000 square yards, in completion of the contract, of which 21,830 cubic yards of dredging has been done during the present year. By these operations the main channel at this place has been opened to a depth of 23 feet at mean low water (or 33 feet at mean high water) for a width of 125 feet throughout the whole extent of this shoal. The adopted project calls for a width of 300 feet when completed.

4. A large and dangerous sunken rock, recently discovered and located in the main channel in Broad Sound, was broken up and removed in August and September last. This rock had a depth of but 9 feet of water on it at mean low water, with a depth of 16 feet around it. After several attempts to find it, it was discovered by the aid of a diver who had been employed on a vessel which had run upon it in April last.

By the operations of the past year, as above described, all the work hitherto projected for the improvement of Boston Harbor proper has been completed, with the exception of that at Anchorage Shoal, where it is projected to open the main ship-channel to a least width of 1,000 feet.

By the River and Harbor Act of June 14, 1880, the sum of \$75,000 was appropriated for the improvement of Boston Harbor to be applied as follows, viz. :—

1. Boston Harbor proper	\$30,000
2. At the mouth of Charles River, in said harbor, and up to Watertown	22,500
3. At the mouth of Mystic River, in said harbor	17,500
4. From said harbor to Nantasket Beach	5,000

Under this appropriation the following work has been done for improving navigation at the several places named, viz :—

1. *Boston Harbor proper*.—A contract has been made with Messrs. Moore & Wright of Portland, Me.,—the lowest of five bidders,—for 65,000 cubic yards, more or less, of dredging at Anchorage Shoal, at 39 cents per cubic yard, *measured in scows*, the same to be completed on or before the 30th of June, 1881. Preparations are being made to commence this work on or about the 1st of January. It is probable that under this contract this channel will be opened for an additional width of about 325 feet, and a total of 875 feet.

2. *At the mouth of Charles River, in said harbor, and up to Watertown.* — A survey of Charles River was made in 1878 with a view to its improvement from its mouth up to the head of tide-water at Watertown. The project for its improvement consists of opening the channel *first*, from its mouth up to Western-avenue Bridge (a distance of about $4\frac{3}{4}$ miles) to a depth of not less than 7 feet at mean low water (or about 17 feet at mean high water) for a width of 200 feet; *second*, from Western-avenue Bridge up to Market-street Bridge (an additional distance of about $3\frac{1}{4}$ miles) to a depth of not less than 6 feet at mean low water (or about 16 feet at mean high water) for a width of 100 feet; and *third*, from Market-street Bridge up to the dam at the head of tide-water (an additional distance of about $1\frac{3}{4}$ miles) to a depth of 3 feet at mean low water for a width of 75 feet. The estimated cost of this improvement, at the prices now ruling, is \$125,000. In commencement of this work under the appropriation made therefor, as above (to wit, \$22,500), a contract has been made with Messrs. Moore & Wright of Portland, Me., — the lowest of four bidders, — for 50,000 cubic yards, more or less, of dredging, at 39 cents per cubic yard, *as measured in scows*, the same to be completed on or before the 30th of June, 1881. Operations were commenced under this contract in the latter part of November, and have been continued to this date. It is expected that, with the amount now available for this river, its improvement will be completed, as projected, up as far as Western-avenue Bridge.

3. *Mouth of Mystic River.* — Under the appropriation of \$17,500 made by act of June 14, 1880, for improving the channel at this place, a contract has been made with Messrs. Moore & Wright of Portland, Me., — the lowest of five bidders, — for 50,000 cubic yards, more or less, of dredging, at 29 cents per cubic yard, *as measured in scows*, the same to be completed on or before the 30th of June, 1881. Operations were commenced under this contract in November last, and have been continued to this date. It is expected that, with the amount now available for this work, the channel will be opened to the projected depth of 23 feet at mean low water for an additional width of about 120 feet, — making a total width of about 245 feet, the full projected width being 300 feet.

4. *Nantasket Beach Channel.* — In order to ascertain the nature and extent of the improvements contemplated for this place, a survey has recently been made of this channel from its head at Nantasket Beach down to its outlet at World's End; and the project adopted for its improvement consists in straightening, widening, and deepening the channel by dredging, and by the removal of sunken ledges from the mouth of Weir River up to the steamboat-wharf (a distance of about 600 yards), so as to have a depth of 9 feet at mean low water (or about 19 feet at mean high water) for a width of 100 feet. A contract for the dredging (*viz.*, 15,000 cubic yards, more or less) has been made with Mr. Robert Hamilton, jun., of Chebeague Island, Me., — the lowest of three bidders — at $18\frac{3}{4}$ cents per cubic yard, *as measured in scows*, the same to be completed on or before the 15th of May, 1881. In addition to the dredging, about 12 cubic yards of sunken ledge will also have to be removed. The unexpended balance now available will be sufficient for completing this work.

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The estimated cost (additional) for completing all the improvements projected for the harbor and rivers, as above, is as follows :—

1. Anchorage Shoal	\$37,500
2. Mystic River Shoal	10,000
3. Charles River	102,500
Total	\$150,000

For these works the sum of \$125,000 has been asked to be appropriated by Congress for the next fiscal year.

II. IMPROVEMENT OF MERRIMAC RIVER, INCLUDING NEWBURYPORT HARBOR, MASSACHUSETTS.

The present project for the improvement of this river was adopted in 1870, and modified in 1874 ; the object being to afford a channel of navigable width, and a depth of not less than 9 feet at mean low water (or about 16½ feet at mean high water) from its mouth at the outlet of Newburyport Harbor up to Deer Island Bridge, a distance of about five miles ; and thence up to Haverhill Bridge (an additional distance of 12½ miles), a depth of 12 feet at ordinary *high* water, the rise and fall of tides varying from 7½ to 4 feet ; and thence up to the head of the "Upper Falls" (an additional distance of 4 miles), a depth of not less than 4½ feet in the ordinary stages of the river with the mill-water at Lawrence running ; the rise and fall of the tide varying from 4 feet at Haverhill to 0 at the foot of the "Upper Falls."

The natural channel of this river was very narrow and crooked in several places, and much obstructed by sunken ledges, bowlders, and shoals ; and especially at "the falls," portions of which were covered with bowlders and ledges more or less bare, and impassable for any vessels or scows ; whilst in Newburyport Harbor the channel was obstructed by numerous sunken ledges, crib-work piers, and wrecks, seriously endangering navigation.

Previous to January, 1880, the work done for the improvement of this river consisted in opening the channel above Haverhill and through "the falls" to the projected width and depth, in places where absolutely necessary to make its navigation practicable ; also, in dredging at Haverhill, between the bridges, and at Silsby's Island Shoals, as well as at Currier's Shoal (about 4 miles below Haverhill), and at Rock's Bridge (6¾ miles below Haverhill), including the removal of a large number of dangerous sunken rocks at and near Rock's Bridge and the head of Silsby's Island ; also, in Newburyport Harbor, in the partial removal of Gangway Rock and North Rocks, and in the removal of a sunken wreck.

By the River and Harbor Act of June 14, 1880, the sum of \$12,000 was appropriated for continuing the improvement of Merrimac River, which, with \$3,092 available from the appropriation of March 3, 1879, made \$15,092 available for this work. This amount has since all been applied to the improvement of the river, as follows, viz. :—

1. *At and near its Mouth in Newburyport Harbor.*— Under a contract made with Mr. James Andrews of Biddeford, Me., — the only bidder, —

for completing the removal (commenced in 1870) of Gangway Rock, at \$30 per cubic yard, *measured in situ*, this work was completed by him between the 11th of September and the 8th of October, 1880, whereby the rock was broken up and removed to a depth of 9 feet below the plane of mean low water, or $16\frac{7}{8}$ feet at mean high water, requiring the removal of $22\frac{1}{2}$ cubic yards of ledge above that plane.

A submarine party, with a sloop provided with suitable steam-drills and hoisting apparatus, was also employed by the day in the removal of the following obstructions in Newburyport Harbor, to wit:—

First, Six sunken piers and one sunken scow lying directly across the main channel one-half a mile above its mouth at Salisbury Point. These piers had about 5 feet of water over them at mean low water, and were built of crib-work, and ballasted with stone; and, it is said, they were placed there in about 1812 and previous thereto in order to prevent the entrance of hostile vessels into the harbor. By means of the submarine parties, two of these piers and one scow were discovered during these operations. These piers and scow were all broken up, and removed to a depth of not less than 9 feet at mean low water.

Second, The wreck of the schooner "Greyhound," sunk in November, 1879, was broken up, and removed from the main channel at the entrance of the harbor.

Third, A large sunken rock (ledge) lying in mid-channel between the north and south piers was broken up, and removed to a depth of 12 feet at mean low water, containing altogether about $6\frac{1}{2}$ cubic yards; and other shoal points of ledge situated in the main channel near North Rocks and the mouth of the river were in part broken up and removed. These submarine operations were carried on between the 28th of July and the 11th of September, and afterwards between the 9th and 31st of October, 1880.

2. *At and near "the Falls" above Haverhill, and at Rock's Bridge, $6\frac{3}{4}$ Miles below Haverhill.*—Under a contract made with the Pentucket Navigation Company for the removal from the channel at the "Lower Falls" of $95\frac{1}{2}$ cubic yards of sunken ledge, at \$30 per cubic yard, *measured in situ*, this channel has been completed to its full projected width and depth. This work was commenced in September, 1879, and completed on the 25th of October, 1880.

For the further improvement of the channel at "the falls" and Rock's Bridge, a dredging-machine and scows (specially adapted to this work), with full crews for the same, were hired by the day, at \$75 per working-day of ten hours. Dredging operations were commenced at the Upper Falls on the 30th of July, and continued to the foot of the Lower Falls till the 2d of November; during which period the channel at the Upper Falls was straightened, widened, and deepened where necessary for the completion of the same. The channel at the Lower Falls and below was also widened and straightened; and with the aid of a diving party, a very large quantity of ledge and boulders was broken up, and removed from the channel throughout the whole extent of "the falls." The unusually low stage of the river this season facilitated these operations to a degree seldom to be experienced, and for this reason they were continued until

a rise of water. On the 10th of November the dredging-machine and diving party were transferred to Rock's Bridge, where they were employed until the 20th of November in deepening the channel and in removing numerous large bowlders by which navigation had been much endangered at that place.

By the operations above described, the navigation of the river has been very much improved during the past season. But more work still remains to be done, especially in the removal of sunken rocks at Rock's Bridge and in Newburyport Harbor, for effecting all the improvements necessary.

An additional appropriation of \$16,500 has been asked for this work.

III. IMPROVEMENT OF NEWBURYPORT HARBOR, MASSACHUSETTS.

By the River and Harbor Act of June 14, 1880, the sum of \$50,000 was appropriated for the improvement of this harbor, which it has been decided to apply to the improvement of the shifting and uncertain channel at its entrance by means of rubble-stone jetties. With a view to a proper understanding of the bar and currents at its entrance, as well as of the material composing the bar, and all other facts bearing upon this subject, a very accurate survey was made of this locality in July and August last. A new project, based upon this survey, was submitted to the War Department in September last, which has since been approved and adopted. It consists of two converging rubble-stone jetties built out from the shores north and south of the entrance to such an extent as will secure a constant depth of $13\frac{1}{2}$ feet across the bar at mean low water, or 21 feet at mean high water. The estimated cost of these jetties, together with the shore protections at the extremities of Salisbury Beach and Plum Island, is \$240,000.

Under the appropriation made, as above, for this work, a contract has been made with Mr. Frederic A. Ingerson of Haverhill, Mass., — the lowest of four bidders, — for furnishing and placing in the northern jetty (beginning at its shore end) 50,000 tons, more or less, of rubble-stone in commencement of this improvement, the work to be commenced on or before the 1st of April next, and the contract to be completed on or before the 30th of November, 1881.

IV. IMPROVEMENT OF SCITUATE HARBOR, MASSACHUSETTS.

A survey of this harbor was made by Gen. Thom in 1878, "with a view to its adaptability as a harbor of refuge;" based upon which a project was made and submitted to the War Department, with estimates of cost for the same. This project consists of two rubble-stone jetties, or breakwaters, built at the entrance of the harbor: one to project from Cedar Point near the lighthouse on the north side of the entrance, in a direction south, 36° east, for a distance of 800 feet; and the other to project from the point of the first cliffs on the south side of the entrance, in a direction north, 10° west, for a distance of 730 feet, being so located as to shut out all easterly winds from the proposed harbor, and also to occupy the shoalest and most favorable sites in regard to cost.

In connection with the jetties, it is proposed to excavate a basin inside of sufficient area for the harbor, with a depth of 10 to 12 feet at mean

low water, or about 20 feet at mean high water; the greatest depth at present being not more than about 5 feet at mean low water on a very small area: also to excavate a channel, so as to afford an easy ingress into the harbor with a constant depth of not less than 10 feet at mean low water.

The estimated cost of this improvement, as revised for the project adopted, is \$225,000.

This project has been approved by the War Department, and the construction of the jetties will be commenced as soon as a sufficient appropriation shall be made by Congress to justify it. By the River and Harbor Act of June 14, 1880, the sum of \$7,500 was appropriated therefor.

V. IMPROVEMENT OF PLYMOUTH HARBOR, MASSACHUSETTS.

All the works projected for the protection and preservation of Long Beach (which gives to this harbor its only shelter from easterly storms) were completed in 1879; but, exposed as they are to injury from those violent storms, they will necessarily require occasional repairs. They are now in an essentially good condition, and fully answer the purpose for which they were designed.

For the improvement of the harbor itself, the sum of \$10,000 was appropriated by the River and Harbor Act of March 3, 1875, by which a channel about 50 feet in width was opened by dredging from the Middle Ground up to Long Wharf, — a distance of about 2,500 feet, — to a depth of 6 feet at mean low water, or 16 feet at mean high water.

The project for the improvement of this harbor provides for a channel 6 feet in depth at mean low water, and 100 feet in width, up to Long Wharf; and thence extended southward to the mouth of Town Brook, — a distance of about 900 feet above Long Wharf, — so as to form a basin in front of the wharves of the town 125 feet in width, with a depth of 8 feet at mean low water.

For continuing this improvement, the following sums have since been appropriated by Congress, to wit: —

By the River and Harbor Act of March 3, 1879	\$3,500
By the River and Harbor Act of June 14, 1880	10,000
Total	\$13,500

Owing to the smallness of the appropriation of 1879, it was decided to wait for an additional appropriation before doing any thing further towards the completion of this work.

With the above amount available (\$13,500), a contract has been made with Messrs. Robert Hamilton, jun., and Solomon Sawyer, of Maine, — the lowest of four bidders, — for 60,000 cubic yards, more or less, of dredging, at 17 cents per cubic yard, *measured in scoops*; the same to be completed on or before the 30th of June, 1881. The contractors commenced dredging under their contract on the 11th of November, 1880, and have continued it up to the close of the year, whereby the channel has been opened to a width of about 70 feet, with the projected depth.

For completing this improvement to the extent projected as above, an

additional appropriation of \$11,500 has been asked for, to be expended in the next fiscal year.

VI. IMPROVEMENT OF PROVINCETOWN HARBOR, MASSACHUSETTS.

All the works projected for the protection, preservation, and improvement of this harbor, have been completed, with the exception of the bulkhead on Long Point. These works are all in good condition, and fully answer the purpose designed. They will, however, require continual watching and occasional repairs.

Under the appropriation of \$500 made by the River and Harbor Act of June 14, 1880, together with the unexpended balance of the appropriation of March 3, 1879, aggregating \$1,112.17, repairs have been made where most necessary, — on the bulkhead on Long Point, in which 664 $\frac{8,000}{2240}$ tons of rubble stone has been used.

For completing the stone bulkhead on Long Point, and making repairs on other works where necessary, an appropriation of \$7,000 has been asked for the next fiscal year.

VII. SURVEY OF MALDEN RIVER, MASSACHUSETTS.

By the River and Harbor Act of June 14, 1880, provision was made for the survey of this river, with a view to the improvement of its navigation. This survey has since been completed, and a project for its improvement, with an estimate of its cost (amounting to \$35,000), has been submitted to the War Department for the information of Congress.

This project consists of straightening, widening, and deepening its channel from its mouth up to the bridge near the rubber-works in Malden, — a distance of about two miles, — so that vessels drawing 10 feet of water can ascend to that bridge on the high water of neap tides in a channel 100 feet in width.

[F.]

STATEMENT OF OPERATIONS DURING THE YEAR 1880
ON WORKS FOR THE IMPROVEMENT OF RIVERS AND
HARBORS IN MASSACHUSETTS, UNDER THE CHARGE
OF BREV. MAJOR-GEN. G. K. WARREN, LIEUTENANT-
COLONEL OF UNITED STATES ENGINEERS.

[A.]

SURVEY OF NANTUCKET HARBOR, MASSACHUSETTS.

It must be noted that the wording of the act does not specify any particular place of improvement; whether to deepen the water on the bar at the existing entrance, which the United States undertook to do by dredging in 1829, '30, '31, or to attempt to make an opening through the Haulover Beach into the "upper harbor," a scheme that has several times been brought up for consideration, and notably so in the reports accompanying the Annual Report of the Board of Harbor Commissioners of Massachusetts for the year 1872, and there recommended as "an experiment" "worth an earnest trial."

That the Nantucket Bar has always been an obstruction, and of a most serious character too, is unquestionable. The survey made by Lieut. Jonathan Prescott, First United States Artillery, reported Jan. 13, 1829 (printed, House Representatives, War Department, Document 97, 2d session Twentieth Congress), gives the depth on the shoalest bar as "6 feet at low water." Lieut. Prescott does not state what low water is meant, whether mean or extreme; but it is probable that mean low water is intended.

The United States Coast Survey charts of the survey of 1846 show 6 feet at mean low water. Further soundings by the United States Coast Survey in 1865 show still 6 feet as the limiting depth. The survey made by me in 1874 shows about the depth of 6 feet at mean low water; and our examinations this year show a depth of 6 feet at mean low water. (The mean rise of the tide is about 3 feet. Spring tides range about 4 feet, so that low water of spring tides would not give more than $5\frac{1}{2}$ feet on the bar, and the extreme low waters of very rare occasions may not allow more than 4 feet.)

It does not appear, then, as a fact that the bar has, during the past few years, become a greater obstruction by a lessened depth thereon; but the line of deepest water is frequently shifting. This is supposed by some to be due to changes produced by the ice lodging upon the bar in winter, and the changing appears to have been principally on the outer shoals, and always in a direction to the eastward.

It is a fact that the mail-steamer experienced unusual delays in the early part of the present year, but this was owing to the new channels which had formed not being found. Capt. Gibbs, of the lighthouse steamer "Verbena," however, sounded and buoyed the new channel-line, which, as our recent survey shows, has the normal depth of 6 feet at mean low water as its limiting shoal, just as it has been heretofore. I believe it is conceded now, even by those who draughted the memorial, that the depth on the bar is as great as it has ever been.

While on the matter of obstruction to entering Nantucket Harbor, it may as well be stated that the ice in winter does not generally prevent the mail-steamer going out and in. Some winters she loses one, two, or three days. In the experience of forty-eight years—the first steamer was put on in 1831—there were not more than five winters when fifteen days were lost. In the winter of 1856, '57, thirty to forty days were lost.

There is here a large miscalculation as to the size of this head of the harbor, which includes only the part between Pocomo Head and the Haulover Beach, this part being separated from the rest of the harbor by a shoal not having more than 1 to 2 feet depth on it at low water.

According to the United States Coast Survey charts, the whole area of the upper harbor between Pocomo Head and the Haulover at low water is 1,920 acres, or 3 square miles; the area having 6 feet at mean low water, 960 acres, or $1\frac{1}{2}$ square miles; the area having 12 feet at mean low water, 280 acres, or $\frac{2}{3}$ square mile; the area having 18 feet at mean low water, 128 acres, or $\frac{1}{2}$ square mile.

*Practicability of making a Permanent Opening through the Haulover
Beach 9 or 10 Feet Deep at Mean Low Water.*

After a full discussion of this project Gen. Warren expresses the following opinion: "It appears to me that from the foregoing showing there is very little reason to believe the experiment will ever succeed. It is with great regret, as far as it disappoints honest expectations, that I am compelled by my honest judgment to say so."

The Project of Improving the Present Entrance to Nantucket Harbor.

A consultation of ordinary maps, and particularly the charts of the United States Coast Survey, presents so good an idea of the general features of this harbor and island, that a description is not necessary.

It has been stated in the first part of this report, that there is and always has been, since the occupation of the island, a limiting navigable depth at the entrance of about 6 feet at mean low water. The shoal is of great breadth, with channel poorly defined, and is composed of sand, easily moved by waves and currents, so as to change from year to year. The outer part of the bar was found by Lieut. Prescott, in 1828, to be composed of sand for a thickness of 3 feet, and below that of hard blue clay. This determination has not since been repeated. If this clay underlies the sand for any considerable extent of the bar, it would indicate the base of the bar to be probably composed of glacial deposit similar to many parts of the island.

Nantucket Island, in recent times, does not seem to suffer much from the abrasion of the sea, its shores being nearly everywhere protected by a beach of sand. Observation shows that this sand probably comes from the waste of the south shores of Martha's Vineyard Island, particularly the high cliffs near its west south shore.

The motion of this sand along the shore of Martha's Vineyard Island is eastward. Falling into the Muskeget Channel (separating it from Nantucket) large portions are carried seaward, forming Wasque (Waque) Shoal, and the remainder crosses this channel, and forms Tucker-nuck and other shoals to the west of Nantucket. It is probable that a portion of this sand, which is moved by the waves across the Muskeget Channel, keeps moving eastward, both on the north and south sides of Nantucket Island; thus contributing to the bar at the entrance to Nantucket Harbor, and to the beach on the south shore of Nantucket Island.

The form of the Coatue Beach, east of the entrance, indicates also a motion of the sand in the contrary direction, westward from Great Point; but this is probably only a wave-shore motion from the point towards the hollow of the great bend of the shore, while the eastward motion of the sand from Muskeget Channel is due to the combined power of the waves and currents, whose sands in part the waves throw upon that shore.

The position of Point Rip, off and east of Great Point (see Diagram A), indicates that the sand brought here is mainly deposited on the east side, so that the sand coming around from the south by the east side of the island does not come into Nantucket Sound.

If now we compare Nantucket Harbor with Edgartown, we see that there is no drifting sand from the west to the east across the north side of Martha's Vineyard, as in the case of Nantucket, and consequently no supply of sand to fill up Edgartown entrance, as in the other case. Edgartown entrance was, therefore, deeper than Nantucket entrance, from causes independent of the southern opening the former had through Cotamy Beach; and the closing of this latter has in no way injured Edgartown Harbor. Hence there is no reason to think that an opening through the Haulover will make Nantucket entrance like that at Edgartown, and the cases are so dissimilar that we cannot conclude that it may not be an injury at Nantucket if we make a permanent opening through the Haulover.

Assuming, then, as reasonable, that the sands at the Nantucket Bar come from the west through the Muskeget Channel, and are spread out over the sound, it is probable that the north winds and their waves drive this upon the hollow bend of the Nantucket shore, and that the littoral wave-motion works the sand both east and west towards the entrance, as there is a sand-spit on both sides, although that forming Coatue Beach on the east is much longer than that known as Brant Point on the west.

The sand-spits, thus maintained by littoral sands moving towards the ends, approach each other as closely as the water entering and leaving the tidal basin will allow; and then the sand which reaches the ends is washed away by the current, some going to fill up the harbor, and some going to form the bar outside.

The overlapping of the Coatue Point shows that the supply from this direction exceeds that from Brant Point, and this condition gives a direction to the issuing or ebb current towards the north-west. But at the outer part of the bar (nearly one mile distant) the currents of the sound are nearly always eastward, so that a new direction is given to the line of deepest water there, and the channel has for years past been moving eastward at its outer end.

Plan of Improvement of Nantucket Bar.

This bar (independent of what influence the underlying clay reported by Lieut. Prescott has) corresponds in its formation with many other bars at the entrances to enclosed basins made by beaches formed by littoral sands extending across the points of headlands. The treatment of such is well established in practice to be the erection of jetties to stop the motion of the littoral sand, and concentrate the action of the tidal currents to scour and maintain a channel between them. Generally a jetty on each side is required; but sometimes one will suffice, and one can generally be tried with safety to the project, and let the necessity for the other be determined by the result. This seems to be the case at Nantucket. As early as 1828 Mr. Zenas Coffin of Nantucket—a man of wealth, whose descendants are still there—contemplated driving a row of piles from Coatue Point, on the east side of the entrance, and talked about it so that it is well known and remembered. Other Nantucket men have suggested to me a jetty here too.

In regard to the use of piles, I do not think they will answer except as an auxiliary, for the ice in winter might move them bodily.

I, however, prefer the placing of the jetty on the west side of the entrance, keeping during its erection such a watch upon Coatue Point that no injurious change shall occur there.

The jetty I propose is to be triangular in section, with side slopes of 45 degrees; the top to be 5 feet above mean low water for a distance of 4,000 feet from the shore; the outer 2,500, being more exposed to the action of the waves, should be 4 feet wide on top, with the same side slopes and the same height. The outer end, or head, being in deeper water, should have increased dimensions to meet the greater shock of the waves and effect of ice to which it will be exposed. The jetty is to be of large riprap stone, dropped immediately upon the line of the work; or, as it is a shallow bar and much exposed, it may be better to land the stone inside the harbor on Brant Point, and lay a railway track (probably a mile long), carry the stone to the point on the shore where the jetty is to begin (see Diagram A), continue the railway on piles out along the line of the jetty, and drop the stone as the track advances.

The following is the estimated cost of a jetty of the above description:—

First section, 4,000 feet, 7 tons of riprap per linear foot, stone to average $1\frac{1}{2}$ tons, 28,000 tons.

Second section, 2,500 feet, 12 tons per linear foot, stone to average $1\frac{1}{2}$ tons, 30,000 tons.

Total, 58,000 tons, at \$1.75 \$101,500 00

Add for contingencies 10,500 00

112,000 00

It is thought that this improvement could be carried on to ultimately increase the depth to 12 to 14 feet or more; but to do this a second jetty may be required, which, in general terms, may double this estimate.

No benefit could result unless at least one jetty was completed: so it is urged, if the plan proposed to improve the present entrance is attempted, that the whole amount for the first jetty be appropriated in one, or, at most, two years.

Recapitulation of Estimates.

First, For a channel through the Haulover, 10 feet wide and 2 feet deep at mean low water, \$1,200.

Second, For a channel through the Haulover, 6 feet deep and 100 feet wide, and for a channel 6 feet deep thence to the wharves, \$32,000.

Third, For a jetty on the west side of the entrance to the harbor to increase the depth on the bar, \$112,000.

[B.]

WORK IN WOOD'S HOLL STRAITS.

The principal work has been in widening and straightening what is known as the Lone Rock Channel, which passes between Grassy Island on the north and Red Ledge on the south, and which was before the work commenced not more than 30 or 40 feet wide and very crooked. It is now direct and 120 feet in width, with a depth of not less than 9 feet at mean low water; and 140 feet wide, $7\frac{1}{2}$ feet deep, at same time of tide.

Although what has already been done has greatly facilitated the passage of the Wood's Holl Strait by the passenger steamboats now running through it, the channel should still further be enlarged for the use of the government steam-vessels and the more general class of coasting-steamers, as originally designed; and there can be no doubt that the full plan of enlargement for sailing-vessels should also be prosecuted to completion.

Work proposed for the Fiscal Year ending June 30, 1881.

Work will be continued until the funds available are expended in widening the present channel by removing bowlders.

No appropriation was made for this work by Act of June 14, 1880, and nothing further can be undertaken.

To make the steaniboat channel 200 feet wide and 9 feet deep at low water, the original estimate was \$22,000, and will require an additional appropriation of \$12,000. The work is of such a nature that any expenditure upon it is a part of the final improvement designed and estimated for the use of sailing-vessels. The amount that could be advantageously expended on this work in the fiscal year ending June 30, 1882, is \$50,000. It is recommended that this amount be appropriated.

[C.]

SURVEY OF WAREHAM HARBOR, MASSACHUSETTS.

General Description of the Harbor.

This harbor is an estuary of Buzzard's Bay. It is about 13 miles east of New Bedford, and 6 miles west of Monumet, the southern end of the proposed Cape Cod Ship Canal.

It is about 3 miles in length, with a width varying from 200 feet to more than $\frac{1}{2}$ a mile.

Into this estuary empty Agawan River at its head, draining about 45 square miles; Broad Marsh River on the west side, draining 4 square miles; and Weweantic River on the west side, below Long Beach, draining 95 square miles.

A small stream, called Crooked River, draining but 1 square mile, empties into it from the east.

The shores for the most part are low, with extensive marshes that are submerged by spring tides.

The harbor, commencing at the rail and highway bridges at Wareham, which, not being provided with draws, prevent any navigation above them except by barges, is about 200 feet wide. At the south end of the Franconia Iron Company's Wharf, 1,400 feet further down, it is 400 feet wide; from this point it opens out into a bay 2,000 feet in width. Near the mouth of Broad Marsh River it narrows to about 900 feet, which width it retains for about 1,200 feet, when it again widens into a bay more than $\frac{1}{2}$ a mile wide.

This bay is separated from Buzzard's Bay by Long Beach, which extends from the east shore out about 2,000 feet. This beach is composed of sand. At low-water level the sand is coarse, with gravel and pebbles; above low water it is fine, and easily moved by wind or waves. The width of the beach at low water varies from 200 to 800 feet; at ordinary high water a narrow strip of sand, not more than 100 feet wide in the widest part, is above water. At high water of spring tides the whole beach is submerged.

Outside of this beach is an extensive shoal or flat, the curve of 6-foot depth being $\frac{1}{4}$ of a mile distant at the east end, and more than $\frac{1}{2}$ a mile at the west end. The water on the inside of this beach is bold; at the west end of it a vessel drawing 9 feet can at low water approach within 50 feet of the high-water line.

Precious Surveys.

A survey of this harbor was made in 1870 under direction of the Harbor Commissioners of Massachusetts. The report upon this survey appears in their Fifth Annual Report, 1871, and is as follows:—

"During the past year the Board has had made a careful survey of Wareham River, with a view to the establishing proper harbor-lines, and the determination of the causes that have led to the formation of shoals near the wharves. They also have in mind to apply to Congress for the removal of the bar that has formed at the mouth of the river, should the

results seem to justify such action. The great importance of this port, and the extensive manufactures carried on there, call for a serious effort to improve the navigation of this river, upon which the prosperity of the place almost wholly depends."

In their next annual report a comparison is made between the condition of the harbor in 1845, as shown by the United States Coast Survey, and by their survey of 1870. This comparison showed that marked changes had taken place in the upper part of the river. Of this they say, "It can hardly be questioned that the construction of the solid pier between the west side of the river and the sluice-way, or bay, through which scows and boats now pass, and the solid embankment of Cape Cod Railroad on the west side of the river, together with the stone ballast which has been thrown around and between the piers of both the railroad and town bridges, have contributed mainly to the injury sustained, and have caused the violent and unequal currents which have dug out, as it were, the deep holes above, between, and below the bridges, and thrown up the abrupt and injurious shoals beyond them."

The injurious effects of the bridge structures they think is "confined to about the first 400 feet below them."

In regard to these they say, "While there is no doubt that the physical condition of this upper portion of the river could be improved by the removal of the railroad embankment, the whole, or a part, of the solid pier near the centre of the river, the stone ballast from under each of the bridges, and the reconstruction of the railroad piers, it would be a measure of doubtful economy. It is the opinion of the Board, that the river could be improved, and the improvement maintained, for a much less sum than it would take to remove and remodel the objectionable portions of the existing structures."

Harbor-lines were established by the Board on both sides of the river from the bridges at the upper end to Barney Point.

In 1871 a survey was made under direction of Gen. George Thom, United States Engineer, in accordance with a resolution of the House of Representatives. The report upon this survey, including estimates for improving the channel, was published in the Annual Report of the Chief of Engineers for 1872, pp. 973-976.

The map of the survey of the harbor, made in 1870 by Professor H. L. Whiting for the Harbor Commissioners, was used as a basis for the survey of 1871 under Gen. Thom. Additional soundings were taken, and current observations made on the flood and ebb tides at the railroad bridge and at Quahaug Bar. The soundings were reduced to the plane of mean low water established in 1870.

The plan of improvement estimated for and recommended by Gen. Thom was dredging a channel 250 feet wide and 9 feet deep at mean low water through Quahaug Bar, and straightening and widening the channel through the "upper bar;" estimate was also made for removing a large boulder near the mouth of Weweantic River, — the whole to cost \$45,000.

History of Improvements made.

In 1872 Congress made an appropriation of \$10,000 for the improvement of this harbor; another appropriation of \$10,000 was made in 1873, \$10,000 in 1874, and \$10,000 in 1875: making a total of \$40,000. Dredging was commenced in 1873, and completed in 1876, making a channel from 250 to 300 feet wide and 10 feet deep at mean low water from Long Beach around Quahaug Bar; thence, by cutting off shoal points, a least width of 200 feet was made to the "upper bar." Thence to the bridge, at the upper end of the harbor, the width decreased to 100 feet; the depth made in this part was 9 feet at mean low water.

During the progress of the improvement in 1873, a detailed survey of the harbor was made, as the maps of previous surveys were not sufficiently in detail to serve as a guide in carrying on the works of improvement. This survey showed that there was less depth of water in the harbor than had been previously supposed.

The report of this survey was published in the Annual Report of the Chief of Engineers for 1874, pp. 216-220.

On the completion of the improvement above described, there was about \$1,700 remaining on hand. With this an attempt was made, in 1877, to catch the sand brought along the south side and over Long Beach into the harbor, by building a sand-catch fence. This fence was of a single row of cedar-trees on the higher parts, and on the lower parts of two rows of posts 4 feet apart, connected by stringers and ties placed 1 foot below the surface of the sand. The space between these two rows of posts was filled with brush to about 2 feet above the general surface, this brush being held in place by small stone.

In a storm, accompanied by a very high tide, in the following October, a portion of this fence was washed away. In July, 1878, it was rebuilt, and loaded with larger stone.

The removal of the bowlder in Weweantic River, estimated for in the report of Gen. Thom, was not undertaken, because there was no longer any demand for it.

Survey and Map.

The survey of this season was confined to the channel dredged in 1873-1876, and to the part outside of Long Beach not included in previous surveys. A map of the harbor from the bridges to the "four buoys," outside of Long Beach, on a scale of 200 feet to an inch, accompanies this report. This map shows the present condition of the channel, the depth on the flats and in coves from survey in 1873, the harbor-lines as established by the Harbor Commissioners in 1871, and the channel desired by those interested in the commerce of Wareham and for which estimates are made.

Present Condition of the Harbor.

Beginning at the bridges at the upper end of the harbor, we find in the deep hole, which is undoubtedly caused by the obstruction formed by the embankments, and piers, and riprap protection of the bridges, a depth of

26 feet at mean low water, the same as in 1873. Immediately below this, the shoal with the dredged channel along the wharves to the west has a depth of but 4.1 feet on it. This shoal has increased in size, and now encroaches upon the channel, leaving a width of but 70 feet with 8 feet depth.

From this shoal to the "upper bar," which begins about 900 feet below the Franconia Iron Company's Wharf, the dredged channel has about the same general width and depth as when completed. In some places it has widened by scour, and in some narrowed by deposit.

The channel dredged through the "upper bar," 150 feet wide, and from 9 to 10 feet deep at mean low water, has filled up so that in the shallowest place there is but little more than 7 feet depth at mean low water. This filling is over the whole width of the channel, and for 600 feet along it.

From this bar to the entrance of the harbor at Long Beach but little change has taken place in the dredged channel.

At Quahaug Bar it has narrowed somewhat by filling in from the bar or north-west side of the channel, and widened on the opposite side by scour.

There is now a channel not less than 100 feet wide, and 9 feet deep at mean low water, from the entrance to the "upper bar." The mean rise of tide is about 4 feet, so that vessels drawing about 13 feet can go to the "upper bar" at mean high water, but cannot cross it drawing more than 11.5 feet.

The fence on Long Beach, built to catch the moving sand, is in very good condition, and for much of its length sand has collected about it nearly up to the level of high water. On the part of the beach above ordinary high water, the sand is blown about by the wind so that its height is not much increased by the fence. A storm from the south will fill the sand in along the fence that will be blown out into the water by a northerly wind.

Proposed Improvement.

From a consultation with those interested in the navigation of this harbor, I learned that the depth of the channel made in 1873-76 was deemed by them sufficient for the class of vessels likely to be employed in the commerce of the place if that depth can be maintained.

The width of channel made, they say, is too small to allow vessels to beat in or out, and for this reason valuable time is lost by vessels that come to this port.

This want of width for beating is particularly felt above Barney Point and through the "upper bar." Some trouble is found in getting through the channel at Quahaug Bar, but less than in the upper part.

To meet these requirements will require that the channel through the "upper bar" be made 350 feet wide. The entire removal of the "upper bar" is wanted by those interested, so as to make the pocket of deep water to the east, now used for anchoring boats in, available for beating in; but the harbor-lines, as established, place part of this pocket of deep water inside of the pier-head line.

Estimate is made for dredging the entire space on the "upper bar" east of the present channel to the harbor-line on the east side. This would give a width of 350 feet. This is a greater width than is proposed below, and will require the removal of a large amount of material. We have therefore made an estimate for a channel 200 feet wide through this bar; thence to Barney Point, to widen and straighten the channel to 200 feet, and 10 feet depth; from Barney Point to the entrance of the harbor, to make the channel 250 feet wide in its narrowest part, and 10 feet deep.

A depth of 10 feet is made, so that, when the sides of the cuts are washed down by the waves and by vessels striking them, there will still be a least depth of 9 feet.

The fence already built on Long Beach seems to have determined the feasibility of holding and building up this beach above high water, and in that way cut off one of the sources of supply of sand that now finds its way into the harbor.

The growth of the shoal, of which this beach is the inner margin, and its encroachment upon the lower part of the harbor, have been considerable within the memory of those who sail out of the harbor. A map of Wareham, made by S. Bourne in 1832, shows a wide opening near the eastern shore, and a shoal outside of it. Through this opening, boats went in and out to the fishing-grounds.

This map does not give the depth of water. The map of the United States Coast Survey, made in 1845, is the earliest one on which the depth of water is shown. Since that date the filling has been going on slowly; but the beach is not likely to become permanent unless it is raised above storm-tides, and the sand held against the action of the winds by vegetation.

To do this it will be necessary to build a sand-catcher on the site of the present fence: this to be of brush loaded with stone. It should be built above storm-tides. From this spurs should be built on the south side; these would not require to be so high or strong as the main line. They should be built by beginning at the lowest point of the beach, and building one at first. When the sand fills out to the end of it, another may be built, and so on until the whole beach is widened and raised. As soon as any portion of the beach is above spring tides, it should be planted with beach-grass to prevent the sand being blown away.

Some complaint is made of the narrow channel at the "four buoys," about $\frac{3}{4}$ of a mile below the "beach." An examination of it showed a channel 12 feet deep at mean low water, with a least width of 125 feet, with bowlders on either side of it.

We could not learn that any serious trouble had been experienced here; and, as it is better than we propose to make the channel farther up the harbor, no estimate is made for its improvement.

Pilots find some trouble into the harbor in thick weather, or near night, from their inability to see the westerly end of Long Beach. If they cannot see it, and get out of their course to the eastward, they get ashore on the Long Beach flats. It is thought that a "day beacon" should be built on the west end of the "beach," and thus this danger avoided or lessened.

Estimates.

FIRST ESTIMATE.

Dredging 60,000 cubic yards from channel near bridge, and through "upper bar," 350 feet wide, mud and sand, at 25 cents . . .	\$15,000 00
Dredging 15,000 cubic yards, in widening the channel from "upper bar" to Barney Point, mud and sand, at 25 cents . . .	3,750 00
Dredging 24,000 cubic yards of sand, in widening the channel at Quahaug Bar	6,000 00
Removal of bowlder from channel upper side of Quahaug Bar . .	300 00
For holding Long Beach, 2,000 cords of brush, in place, at \$2 . .	4,000 00
4,000 tons of stone on beach, at \$2	8,000 00
Building spurs, 20, at \$100	2,000 00
Planting beach	1,000 00
Add for contingencies	4,000 00
Total	\$44,050 00

SECOND ESTIMATE.

Same as the first, except the channel through the "upper bar" is 200 feet wide, instead of 350.	
Dredging 36,000 cubic yards from channel near bridge, and through "upper bar"	\$9,000 00
The other items, same as in first estimate	25,050 00
	\$34,050 00
Add for contingencies	4,000 00
	\$38,050 00

[D.]

IMPROVEMENT OF TAUNTON RIVER.

Work proposed for the Fiscal Year ending June 30, 1881.

With the appropriation of \$17,500, made by Act of Congress approved June 14, 1880, it is proposed to begin the improvement as planned for in the above report; viz., "to secure 11 feet of water at mean high tide up to the Weir Bridge," by commencing at the bridge, and working down river.

The work to be done by contract with the lowest bidder, after advertising for proposals in the usual manner.

Respectfully submitted.

G. K. WARREN,
Lieutenant-Colonel of Engineers,
Bvt. Major-General.



PUBLIC DOCUMENT.

No. 11.

ANNUAL REPORT

OF THE

HARBOR AND LAND COMMISSIONERS,

FOR

THE YEAR 1881.



BOSTON:

Hand, Abby, & Co., Printers to the Commonwealth,

117 FRANKLIN STREET.

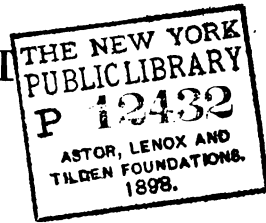
1882.



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FOR

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BOSTON:

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1882.

Commonwealth of Massachusetts.

HARBOR AND LAND COMMISSIONERS' REPORT.

To the Honorable the Senate, and the House of Representatives of the Commonwealth of Massachusetts.

THE Board of Harbor and Land Commissioners, in accordance with the provisions of law, respectfully submit their Annual Report for the year 1881.

SOUTH BOSTON FLATS.

The reclamation of land lying easterly of that heretofore sold to the Boston and Albany Railroad Company and to the New York and New England Railroad Company has made good progress during the year. About two hundred and fifty thousand yards of material dredged from the harbor under operations of the General Government and of private parties have been deposited on the flats lying immediately east of B Street. This has been accomplished at very small expense to the Commonwealth for the construction of bulkheads to retain the filling and for superintending the dumping.

Only a small quantity of material has been deposited under the contract of Aug. 28, 1880, with Thomas Potter, for three hundred thousand cubic yards; but the contractor promises that the entire quantity shall be deposited before Jan. 1, 1883, the time required by the contract.

Under the appropriation of five hundred thousand dollars made last year, the Board decided to obtain as much filling as practicable, using no part of the appropriation for the cou-

struction of piers. Several considerations operated to lead to this decision. By prosecuting the filling as rapidly as possible, the removal of the remainder of the shoal lying in front of the territory already reclaimed will be accomplished at the earliest time practicable. The filling required must be done before any piers which could be constructed would be available for use, and the filling is of necessity a slow process. The great advance which has been made in appliances for the transaction of large business warns us that it must not be assumed that this advance has ceased. Piers and docks planned to meet the most approved methods of to-day might not be all that would be demanded five years hence, and the special needs of those who shall occupy the premises must largely determine what will be required for docks and piers.

A contract was made in August with the New England Dredging Company to dredge and deposit upon the flats to be reclaimed nine hundred thousand cubic yards of material within four years from the approval of the contract. Work was begun immediately under this contract, and is progressing satisfactorily. It will require the removal of only seven hundred thousand cubic yards to take away all that remains of the shoal lying between the channel in front of the reclaimed territory and the main channel, and give twenty-three feet depth at mean low water from East Boston piers to South Boston sea-wall. On the completion of the two contracts now in progress, this depth will be secured, twelve or thirteen hundred feet easterly of what is known as the fifty-acre piece, covering all the frontage now reclaimed and all that will be reclaimed by the material obtained from this dredging. The material obtained under the Potter contract is being deposited next easterly of the fifty-acre piece, and will raise to grade thirteen an area of about fifteen acres; that obtained under the contract with the New England Dredging Company is being deposited, a part immediately easterly of the area covered by the Potter contract, and a part in the rear of this and of the Potter area, and will raise to grade thirteen a further area of about forty-three acres. The area lying between the last-mentioned area and the present line of riparian ownership comprises about thirty-seven acres, and is likely to be filled from miscellaneous sources already mentioned by the time the filling in front is com-

pleted. The filling under the Potter contract and the New England Dredging Company contract is all placed south of a bulkhead erected thirteen hundred feet in rear of the front line of occupation, leaving ample room for the construction of docks and piers twelve hundred feet long. The area left for docks and piers comprises about forty acres, making a total of one hundred and thirty-five acres available for occupation when these are constructed.

The contract with the New England Dredging Company amounts to \$434,000, which with the minor contracts for bulkheads, the completion of B Street, engineer and other expenses attending execution of the work, will substantially exhaust the existing appropriation; but it is not now seen that there would be advantage in entering upon other contracts of importance the ensuing year.

There are still some fractional interests in the area which the Commonwealth attempted to purchase between B and E Streets under the provisions of chap. 446 of the Acts of 1869, which are not yet acquired. $\frac{3}{80}$ of one lot and $\frac{1}{4}$ of another are outstanding. At the price paid for the interests purchased, these outstanding interests amount to \$5,234. The original appropriation having expired, a new appropriation of ten thousand dollars was made by resolve, chap. 61, of 1877, but limited so that no part of the appropriation could be used unless all the outstanding interests were secured. The larger interest could be secured on the same terms as those already purchased, but the smaller could not. Two years later, by chap. 170 of the Acts of 1869, it was provided that three thousand three hundred dollars might be used. This would have been sufficient to have purchased the larger outstanding interest; but during the delay litigation had arisen between the owner and a mortgagee, which suspended negotiation, and the appropriation again expired. The Board recommend a renewal of the appropriation made by the Act of 1877, but without the limitation which imposed the necessity of acquiring all or none.

A contract has been made with the New York and New England Railroad Company for covering B Street with gravel at fifty cents per cubic yard, and the tracks are laid for the execution of the work.

BACK BAY LANDS.

	FEET.
In 1857 the Commonwealth owned on the Back Bay . . .	4,723,998
Of which there have been donated . . . 363,308	
Devoted to streets and passage-ways . . . 2,037,068.60	
Sold as per last report . . . 2,195,789.05	
Sold in 1881 25,238.75	
	<u>2,221,027.80</u>
Remaining for sale Dec. 31, 1881	102,593.60
	<u>4,723,998</u>
The gross proceeds of land sold as per last report	\$4,623,087 02
The gross proceeds in 1881	83,549 75
	<u>\$4,706,636 77</u>
Rights in Parker Street as per last report	2,300 00
	<u>\$4,708,936 77</u>
Cost of filling, grading, etc., as per last report	\$1,626,008 71
Cost of auction sales as per last report	14,291 78
	<u>\$1,640,300 49</u>
Net proceeds to Dec. 31, 1881	\$3,068,636 28
There has been sold in 1881 as follows:—	
2,800 feet Marlborough Street, north side, for	\$11,200 00
3174½ feet Commonwealth Avenue, south side	15,873 75
19,264 feet Newbury Street, north side	56,476 00
	<u>\$83,549 75</u>

The average price per foot obtained was \$3.31, the lowest price \$2.75, and the highest price \$5.

The sales have been much less than last year; but there has been no decrease in prices, and the amount of land remaining unsold is so small that no apprehension is felt that as good prices will not be obtained for all that remains.

The land unsold is located as follows:—

Marlborough Street, north side	16,777.6
Commonwealth Avenue, south side	3,237
Newbury Street, north side	12,320
Newbury Street, south side	26,208
Boylston Street, north side	36,176
Boylston Street, south side	7,875
	<u>102,593 6</u>

The value of the remaining land cannot be less than \$250,000.

By chap. 185 of the Acts of 1875 for the laying-out of public parks in or near the city of Boston, it was provided that any real estate in the city of Boston, which in the opinion of said Board shall receive any benefit and advantage from the locating and laying-out of a park under the provisions of this Act, beyond the general advantages to all real estate in the city of Boston, may, after like notice to all parties interested as is provided by law, to be given by the street commissioners of the city of Boston in cases of laying out streets in said city, be assessed by said Board for a proportional share of the expense of such location and laying out; provided, that the entire amount so assessed upon any estate shall not exceed one-half of the amount which said Board shall adjudge to be the whole benefit received by it. The terms of this provision are certainly sufficiently general and sweeping to include the State House and all the land of the Commonwealth, if no exception is implied. The principle that the property of the Commonwealth is exempt from taxation independent of statute exemptions has been long established, and applied by the court of last resort to taxation for local improvements of a public nature as well as to taxation for general public purposes (116 Mass., 193); and, if the Legislature had intended that the general language of the statute should be construed to include any land of the Commonwealth, it would probably have provided that some agent of the Commonwealth should have authority to pay the assessment on such land. The failure to make such provision, and the fact that the only method of collection provided was by sale of the land assessed, would seem conclusive that it was not intended to make an exception to the general principle, were it not that a different view has been taken by the commissioners acting under the statute, and assessments have been actually made upon land of the Commonwealth on the Back Bay amounting to \$13,495.75. More than half this amount was assessed upon land which had been bargained by the Commonwealth before the park was laid out, and which the Commonwealth was under obligation to convey at a price fixed, and which could not be increased by reason of any effect of the park. Legal proceedings have been instituted by the Attorney-General to test the validity of these assessments, and it is probable that no legislation

will be required. It is proper, however, that the matter should be brought to the attention of the Legislature. If the Commonwealth had not contributed otherwise to the construction of the parks of the city, it might be said that the same equity existed for subjecting the vendible lands of the State to assessment for park construction as existed for subjecting land of citizens to such assessments; but on consideration of all the facts it will be seen that the Commonwealth will not have been wanting in liberal action toward the parks if the general principle so unquestionably sound is allowed to operate undisturbed. By chap. 92 of the Acts of 1881 the Commonwealth authorized the use for park purposes, under the Act of 1875, of 133,400 feet of land lying in Charles River Basin, the money value of which was many times the amount of the assessments in question. By chap. 247 of the Acts of 1866 a grant was made to the city of Boston for similar purposes, though of less extent.

TIDE-LANDS.

There has been received during the year, for land of the Commonwealth occupied by wharves and other structures in tide-water, the sum of \$58,663.75. This amount is much larger than has been received in any previous year since the passage of the Statute of 1874 under which these sums are received.

HARBOR LINES.

In the reports of the Board for 1878 and 1879, the subject of harbor lines for the inner harbor of Boston was presented; and in the latter report, 1879, a scheme was submitted and a description prepared of a series of lines along the frontage of the city proper, from Dover-street Bridge to West Boston Bridge, and of the westerly side of Charles River from West Boston Bridge to the Navy Yard. These lines, as reported and described, were afterwards, by chap. 170 of the Acts of 1880, established as harbor lines.

In accordance with the original intention and general plan proposed, the Board has made a further study and prepared a scheme of lines for the frontage of East Boston from Meridian-street Bridge on Chelsea Creek to Pier No. 4 of the Grand Junction Wharves on the northerly side of the main basin of the inner harbor. A detailed description of these lines is given below.

In confining the project now submitted to the portion of the harbor frontage included within its range, the Board has been guided by considerations of public interest in prescribing lines for those parts of the harbor where improvements and the development of the business occupation of the frontage required the direction and limitation of proposed and progressing structures.

The south-easterly frontage of Charlestown and the westerly side of Chelsea Creek are already well defined by the substantial sea-walls of the United States and those built by the Mystic River Improvement Company. The former have been long in place, and the latter conform to established harbor lines which require no re-statement.

No commercial exigency demands an immediate revision of that part of the frontage of the city of Chelsea lying between Chelsea and Meridian-street Bridges. This part of the water-front of the harbor may, however, require future modification; but it should be made in connection with a comprehensive study of the physical and commercial and economic capabilities of the Mystic River above Chelsea Bridge and of Chelsea Creek above Meridian-street Bridge. The Board has not yet had opportunity (nor means) to make the necessary examinations and surveys upon which such a study should be based, and therefore presents, at this time, no scheme therefor.

In their last Annual Report the Board gave a brief account of the imperfect condition of the harbor line of East Boston, with some explanation of the causes which had led to it, and expressed the opinion, that, while some of the wharves extended beyond the present harbor line, others might be extended without injury to the harbor, and at the same time afford additional commercial facilities of value to the port. A remedy for these defects was suggested, or a mode of dealing with special cases like that of the Boston and Albany Railroad Company, which seemed to the Board a safe and practicable one. No action was taken, however, upon these suggestions; and the difficulties of the situation will be only in part removed by the revision herein recommended: but the Board deem it inexpedient to revise the harbor lines eastwardly beyond Pier 4 of the Grand Junction Wharves at the present time. Legal notice was given, and a hearing

appointed upon the subject of defining the line of frontage between the locality above named and Point Shirley. The hearing was quite fully attended, and large landed and commercial interests were represented. The Board had previously prepared, in their office, a preliminary plan for the general development of this ground; but no other scheme was offered, or plan presented, with which any proper adjustment could be effected, or which harmonized with the present views of the Board. Their experience has proved the value of careful deliberation and cautious action in dealing with schemes which will require long periods of time for execution. The study of such subjects includes, not only perfecting provisional plans for the preservation and improvement of the natural features and functions of a harbor, but often involves important questions of *change*, in regimen and otherwise, which are the more difficult and critical to determine properly. The numerous islands and extensive flats and shoals, and the many natural channel-ways between them, which characterize Boston Harbor, particularly the north-eastern part of it, offer favorable ground for treatment; but it should be dealt with in the most judicious and comprehensive manner. The want of plan and system, in much that was done before organized supervision was established, resulted, not only in the imperfect utilization of many natural advantages, but in serious and irreparable injury.

In determining the scheme of the South Boston Flats improvement, the best available advice was sought, and the best practicable data obtained concerning it. The surveys upon which the outline of the project of improvement was based cost many thousand dollars, and the study of the problems involved was the work of many years. The wisdom of this course has been fully proved by the success of each stage of progress in the work.

Of not less importance, physically and commercially, is the line of frontage, with its outlying flats, between East Boston and Point Shirley. This ground presents many advantageous features, and ample space exists for the location of extensive docks by taking advantage of the natural depths and channel-ways. A scheme for the proper development of this portion of the harbor is a project of about equal magnitude to the South Boston Flats improvement.

The improvement of the frontage between Castle Island and Commercial Point would be also a great addition to the maritime business territory of the port. This line of frontage would be somewhat more exposed than the East Boston and Point Shirley side; but the ground naturally admits of docks of any desirable magnitude, with extensive flats and marshes in the rear, which can be filled and utilized for commercial purposes. These lines of frontage on either side of the harbor are each open to approaches by the main channel below the harbor "middle grounds," and each have direct communication with the anchorage of President Roads. With comparatively slight dredging these lines of frontage will afford a general depth of fifteen feet at mean low tide, and on portions of each line a depth of from twenty to twenty-three feet can be obtained.

Much has been said on the subject of artificial docks in connection with the improvement of Boston Harbor, using this term to designate enclosed basins, which may have within their limits a number of single slips; but no such work seems to be needed. The main inner basin is a natural dock of itself. In fact, the area of sheltered water, as an inner harbor, is of much larger extent than the community in general are aware. The term "inner harbor" is generally applied to the smaller basin above Governor's and Castle Islands and below the bridges, which contains, within the limits of projected improvements, about 1,150 acres. But what is really the *inner harbor*, or may be properly so regarded, is the general area which comprises the water-spaces, including this upper basin, which are enclosed and protected by the high grounds of East Boston and Winthrop on the north, Deer Island and Long Island on the east, and Spectacle Island, Moon Head, and Squantum, on the south,—a nearly land-locked basin, capable of an improved area of not less than about 6,300 acres. This includes President Roads, which in itself contains nearly one thousand acres of anchorage ground of the *first order* as to depth of water (twenty-three to fifty feet at mean low tide), "holding-ground," and shelter. The width of entrance (between Deer Island spit and Long Island head) to this larger inner basin is less in proportion to the water-space enclosed than the entrance to the smaller basin above. It has a natural depth of over fifty

feet, while the entrance to the upper basin has had to be artificially deepened by the General Government to twenty-three feet. The area of this larger portion of the inner harbor, exclusive of the 1,150 acres above Governor's and Castle Islands, is about 5,150 acres. The examination of any approximately accurate chart of Boston Harbor will show at once the relative proportions, situation, and surroundings of the respective water-spaces.

Various opinions have been expressed concerning some of the features of the upper basin, particularly in regard to Bird Island shoal and the channel or water-way between it and the south-easterly point of East Boston. The Board are not in possession of sufficiently recent or accurate data to speak unqualifiedly in regard to these natural features. The channel-way just referred to was not considered by the United States Advisory Council for Boston Harbor of marked physical importance; nor is it one which can be used for even second-class navigation, as required to-day. Nature has determined the main inlet of this upper basin to be between Governor's and Castle Islands, where it has established a depth, in the narrower or more contracted section, of about twenty-seven feet at mean low tide. Its second natural pathway of flowage is between Bird Island shoal and Governor's Island, where it has established a depth at its narrowest section of about twenty-nine feet, with a least depth in the shallowest section of this lateral channel of about sixteen feet. The third inlet or water-way in point of natural consequence is the one above referred to, between Bird Island shoal and the main shore of East Boston, where nature has established a depth of but $9\frac{1}{2}$ feet at mean low tide. How far it may affect the regimen and physique of the harbor to widen and deepen this third-rate channel-way, and to what extent it may be done and not imperil the other channels, particularly the one upon which the General Government has expended so much time and money to improve, are questions of grave importance, which can only be solved by careful study and the calculation of the forces which may affect them.

With regard to the removal of Bird Island shoal by dredging, the scheme in the present opinion of the Board has many serious objections. The shoal answers now as a break-water in strong northerly and north-easterly winds, and pre-

vents what might be an injurious sea-dash upon the quay of the South Boston Flats. The southerly margin of the shoal is quite abrupt, and maintains a remarkable parallelism with the line of the South Boston quay, and exercises with it an important function in confining and directing the tidal currents in their inflow and outflow through the main channel.

The amount of space gained to the area of the upper basin by the removal of Bird Island shoal does not seem to be commensurate with the labor and cost of effecting it. It can hardly be said to be a necessity. The width of the basin between a line which may be made a line of frontage, similar to the South Boston Flats, and the quay of these flats, is about three thousand feet, which is about the same as the width of the Mersey in front of the great docks of Liverpool. The material of this shoal is *solid ground*, and in its natural state capable of sustaining the weight and pressure of any desired structure.

In the rear of Bird Island shoal and between it and Governor's and Apple Island and the main shores of East Boston and Winthrop, is a depressed area of flats traversed by three of the minor channel-ways which characterize this portion of the harbor. In this locality a basin six thousand by five thousand feet square, more than a square mile of area, can be created by the removal of less material, to the space and depth acquired, than would be necessary in any other part of the inner harbor where it could serve like purposes. Such a basin can be so located as to make the outline of at least two of its sides coincident with lines of commercial frontage of the first order.

There is probably no other harbor known to commerce which, in its natural conditions of configuration, marginal ground, basins, channels, entrance, and shelter, is capable of affording equal facilities in so concentrated a manner as the main inner basin of Boston Harbor. It is in general form a hollow square, on each available side of which natural channels mark natural lines of frontage of such a character that docks and piers can be constructed along these lines of any size and depth of approach and berth capacity within the range of the most diversified requirements and with a degree of economy and mechanical facility unparalleled in harbor qualifications. As before stated, these inner harbor basins

contain an area of about 6,300 acres. The preliminary plan prepared by the Board to illustrate the possibilities of the harbor shows that a simple and systematic arrangement could be effected for a series of docks 1,000 feet long and 300 feet wide with alternate piers of equal length and 250 feet wide. The quay of the South Boston Flats between Fort Point Channel and Castle Island admits of twenty such docks and twenty-one such piers, including those already built and in progress of building. According to the plan referred to, a quay can be projected, parallel to that of the South Boston Flats, extending from the termination of the present harbor line at East Boston in the alignment of and coincident with the southerly margin of Bird Island shoal to the abrupt, deep channel which marks its easterly limit. Along this line of frontage five docks and six piers can be provided, and along the southerly face of the shoal about 2,300 feet of quay can be extended; and upon the higher and firmer parts of the shoal the heaviest elevators can be constructed without uncertainty or excessive cost as to foundation. Along the line of quay the largest vessels could have ample berth. From the south-easterly point and termination of this quay a line of frontage at right angles with it can be extended northward along and coincident with the margin of the deep natural channel between Bird Island shoal and Governor's Island to a point in the general alignment of the northerly side of the natural channel which trends nearest to and is most nearly parallel with the shore line of Winthrop. Along this north-and-south line of quay, twelve docks and thirteen piers can be provided. From the northerly limit of this last-named line, and again at about right angles to it, a direct line of frontage can be extended to Point Shirley, along which seventeen docks and eighteen piers can be provided. This estimated number of docks and piers is exclusive of these already existing and in use, excepting those on the South Boston Flats. It is within the angle of these lines of frontage that a basin can be defined and excavated, as previously suggested; and such a basin should be an inseparable part, and is an absolutely necessary factor, in the development of first-class harbor facilities. It is a sacrifice of advantage in the treatment of such ground to extend fillings or excavations on either hand in excess of just that

equilibrium which is the measure of the most economical adjustment of terminal lands with approaches and access to them by channels and basins.

To recapitulate, it will be seen by such a general plan as the Board prepared as a preliminary study, that the total capacity of these remarkable basins within perfectly practicable means of accomplishment is about as follows : —

	DOCKS.	PIERS.
South Boston quay	20	21
East Boston south quay	5	6
East Boston east quay	12	13
Winthrop quay	17	18
	54	58

Each of these docks, as projected on the plan referred to, is estimated as capable of holding four first-class steamers of the present day, and the alternate piers to accommodate their shipping. It will be seen, therefore, that Boston can be made capable of receiving at one time within her port *two hundred and sixteen* of the largest vessels now afloat. There are no natural or practicable difficulties in making most of the docks suggested longer, wider, and deeper than has yet been contemplated. In fact, they can be so located and constructed that any steamer of any size or draught within the probabilities of construction can have berth accommodation and facilities. While the heavier vessels of the present time have now to wait in the open sea for the tide to lift them over the bars of New York and Philadelphia, they can pass into Boston Harbor without detention and without fear. By taking advantage of a channel not generally used, — the “Hypocrite Channel,” between Green and Calf Islands, — a depth of *forty feet* at mean low tide can be carried up to and into President Roads.

Unlike the long extended single line of frontage made necessary by the occupation of river-sites, like the Mersey and the Hudson, where the separation of business centres amounts to miles, the extreme extents of frontage in Boston Harbor, in its form of a hollow square, can be appropriately given in *feet*. The extent of what may be called the southerly basin, along its southerly face from the quay of the city to Castle Island, is about 10,200 feet, equal to about $1\frac{2}{3}$ miles. The north-

erly side, from the south-westerly point of East Boston to the south-easterly point of Bird Island shoal, is about 6,800 feet equal to about $1\frac{3}{10}$ miles. The width of this basin between these parallel quays is about three thousand feet. The easterly water-face of East Boston, according to the plan referred to, is about 7,500 feet, equal to about $1\frac{4\frac{3}{4}}{10}$ miles. The line of frontage along the water-face of Winthrop is about 9,100 feet, equal to about $1\frac{7}{10}$ miles. The distances between extreme points in the general extent of the inner harbor are about as follows : —

	MILES.
From the mouth of Fort Point Channel to Point Shirley, the longest distance from north-east to south-west extremes . . .	4
Mouth of Charles River to Castle Island	3
City quay to Castle Island	$2\frac{1}{2}$
City quay to south-east point of Bird Island	$1\frac{3}{8}$
North-west angle of northerly basin to centre of city quay . .	$2\frac{1}{4}$
North-west angle of northerly basin to Castle Island . . .	$2\frac{1}{4}$
North-west angle of northerly basin to Point Shirley . . .	2
Point Shirley to Castle Island	$2\frac{1}{2}$
Northerly quay of northerly basin to southerly quay of southerly basin, through what may be called Bird Island Channel, — width of southerly basin, — about (3,000 feet) . .	$\frac{57}{100}$

It will be seen, therefore, that the improvement and utilization of the harbor is a work of great magnitude, and as great importance, in the development of which the interests and responsibilities of the Commonwealth demand vigilant supervision.

While it may be unwise to impose too restrictive measures upon private enterprises, no scheme or plan of limited or special purpose should be allowed to prevent or injuriously affect the future development of more important public advantages. It may be and probably is impracticable to repair past injuries, but with acquired experience and better knowledge it would be *inexcusable* if gross mistakes should again occur.

The Board desire to emphasize the doctrine that no scheme of individual or corporate device should be permitted to prevail that is not in accord with the broadest view of the public claim and interest in the harbor.

It may not be out of place in this connection to quote from one of the unpublished able reports of Prof. Henry Mitchell,

of the United States Advisory Council for Boston Harbor, addressed to the Board of Harbor Commissioners when the subject of the protection of the headlands of the harbor was under consideration. Prof. Mitchell says,—

“The great merit of Boston Harbor lies in a happy conjunction of many favorable elements, among which we may distinguish as most important the facility and safety of its approaches, the ample width and depth of its entrances, and, above all, the shelter and tranquillity of its roadsteads. Perhaps there is no other harbor in the world where the inlets from the ocean are better adjusted to the amplitude of the interior basins, or whose excellent holding-grounds are so easy of access and yet so land-locked. I quote from the highest authority in my profession when I declare that the primary requisite for a good harbor is that *‘the internal area should bear such a relation to the width of entrance as to produce a sufficient degree of tranquillity’* * And so difficult has it been to properly adjust this relation in artificial harbors, that nearly one-half of all these works may be set down as failures, because the entrances are either too narrow to admit vessels under trying circumstances, or the interior reservoirs too small to dissipate the waves that run in from the sea. In natural harbors, where the primary requisite, cited above, is fulfilled, it often happens that the interior basin is so large that the local effects of strong winds are sources of discomfort and even danger, as in San Francisco. Boston Harbor has no such drawbacks; her interior water-space is large, but is divided by chains of islands into basins which offer sufficient room for the heaviest ships to ride freely at anchor, and sufficient tranquillity for the frailest fishing-boat.

“There are times when shelter from the wind is scarcely less important than smooth water. In the harbor of Cherbourg the in-run of the waves is most effectually arrested by the great mole, and yet nearly every vessel that sought shelter in the gale of 1865 was driven on shore by the wind. Here again Boston Harbor claims peculiar advantages: her moles are promontories and islands rising from twenty to one hundred feet above the sea.”

The following is the re-statement of the harbor line of East Boston, from Meridian-street Bridge to Pier No. 4 of the Grand Junction Wharves. The particulars of the re-statement are not in precisely the same form and terms as those of the harbor line of Boston city; but the data given are more concise than that first submitted.

* Stevenson on Harbors.

DESCRIPTION OF EAST BOSTON HARBOR LINE FROM MERIDIAN-STREET BRIDGE TO PIER 4 OF THE GRAND JUNCTION WHARVES.

Beginning at a point A on the westerly side of Meridian-street Bridge and about sixty-three feet southerly from the draw, and marked by a copper tack and an iron plate, in lat. $42^{\circ} 23' 06''.233$, long. $71^{\circ} 02' 02''.596$; thence straight south-westerly 817.9 feet to point B, in lat. $42^{\circ} 23' 01''.847$, long. $71^{\circ} 02' 11''.750$; thence straight more southerly 884.3 feet to point C near McKay's Wharf in lat. $42^{\circ} 22' 53''.663$, long. $71^{\circ} 02' 15''.875$; thence straight southerly and a little westerly 1,773.9 feet to point D, the north-westerly corner of Green's Wharf, in lat. $42^{\circ} 22' 36''.144$, long. $71^{\circ} 02' 16''.541$; thence straight southerly and a little more westerly 1,123.4 feet to point E nearly opposite Burnham's dry dock in lat. $42^{\circ} 22' 25''.210$, long. $71^{\circ} 02' 19''.109$; thence straight south-westerly 994.7 feet to point F, the north-westerly corner of Mayo's south wharf, in lat. $42^{\circ} 22' 16''.402$, long. $71^{\circ} 02' 24''.987$; thence southerly 474.6 feet on a curve of 512.3 feet radius tangent at F to the line EF and curving easterly to the point G in lat. $42^{\circ} 22' 11''.879$, long. $71^{\circ} 02' 24''.964$; thence straight south-easterly tangent at G to the curve FG 2,591.3 feet to the point H near the Eastern R.R. and Cunard Wharves in lat. $42^{\circ} 21' 49''.019$, long. $71^{\circ} 02' 09''.421$; thence more easterly along the front lines of the Cunard and Grand Junction Wharves 1,018.3 feet to the point I, the south-easterly corner of Pier 4, Grand Junction Wharves in lat. $42^{\circ} 21' 43''.888$, long. $71^{\circ} 01' 57''.753$.

Geographical Positions of Initial Points of the Harbor Line on the West and South Water-Front of East Boston from Meridian-street Bridge to the South-easterly Corner of Pier Four of the Grand Junction Wharves.

Station.	Latitude.		Longitude.		Azimuth.		To Station.	Back Azimuth.		Distance Meters.	Log. Meters.	Distance Feet.	Log. Feet.
	Deg.	Min.	Sec.	Deg.	Min.	Sec.		Deg.	Min.	Sec.			
A .	42	23	06.233	71	02	02.596					249.30	2.3967170	817.9
B .	42	23	01.847	71	02	11.750	57 07 32	B .	237 07 26		269.55	2.4306374	884.3
C .	42	22	53.663	71	02	15.875	20 29 23	C .	200 29 20		540.70	2.7329566	1773.9
D .	42	22	36.144	71	02	16.541	1 32 57	D .	181 32 57		842.42	2.5345546	1123.4
E .	42	22	25.210	71	02	19.109	9 52 43	E .	189 52 42		303.20	2.4817267	994.7
F .	42	22	16.402	71	02	24.987	26 19 41	F .	206 19 37		144.68	2.1604007	474.6
G .	42	22	11.879	71	02	24.964	Curve.	G .	R=156.15 Met.		789.85	2.8975454	2591.3
H .	42	21	49.019	71	02	09.421	333 14 28	H .	153 14 38		310.37	2.4918853	1013.3
I .	42	21	43.888	71	01	57.753	300 39 59	I .	120 40 07				3.0073530

Geographical Positions of Reference Points and Bearings and Distances connecting them with the Initial Points of the Harbor Lines of East Boston from Meridian-street Bridge to Pier Four of the Grand Junction Wharves.

Refer- ence Points.	Location.	Latitude.	Longitude.	Distance Meters.	Log. Meters.	Distance Feet.	Log. Feet.	Azimuth.	Back Azimuth.	Initial Points.
A	Meridian-street Bridge about 63 feet south of draw opening	Deg. Min. Sec. 42 23 06.233	Deg. Min. Sec. 71 02 02.596	-	-	-	-	Deg. Min. Sec. -	Deg. Min. Sec. -	-
C'	McKay's Wharf	42 22 53.615	71 02 14.935	21.55	1.3334851	70.7	1.8494528	93 56 25	273 56 24	C
D'	Green's Wharf	42 22 36.130	71 02 16.478	1.51	0.1777592	4.9	0.6937269	107 13 30	287 13 30	D
E'	Burnham's Dry Dock Wharf	42 22 23.855	71 02 17.477	56.05	1.7485678	183.9	2.2645355	138 14 01	318 14 00	E
E''	Burnham's Marine R'way Wharf,	42 22 23.494	71 02 19.738	54.86	1.7392810	180.0	2.2552487	195 12 18	15 12 18	E
F'	Mayo's South Wharf	42 22 16.350	71 02 24.964	1.69	0.2291071	5.6	0.7450748	161 26 23	341 26 23	F
G'	Whidden's Wharf	42 22 12.924	71 02 25.290	33.09	1.5197235	108.6	2.0356912	346 58 30	166 58 30	G
G''	Potter & Wrightington's Wharf,	42 22 10.880	71 02 23.843	41.29	1.6158803	135.5	2.1318480	141 36 22	321 36 22	G
H'	Eastern Railroad Wharf	42 21 49.928	71 02 09.814	29.45	1.4630092	95.6	1.9850669	342 13 22	162 13 22	H
H''	Cunard Wharf	42 21 48.552	71 02 08.287	29.68	1.4724333	97.4	1.9884010	119 02 40	299 02 38	H
I'	Pier 4, Grand Junction Wharves,	42 21 43.917	71 01 57.756	0.91	9.9390414	3.0	-	356 01 53	176 01 53	I

DRAWS IN THE BRIDGES ACROSS MERRIMACK RIVER
BELOW HAVERHILL.

By the resolve chap. 23 of the Acts of 1881 the Board was instructed to investigate the subject, and report their conclusions in regard to widening the draws in the bridges across the Merrimack River below Haverhill.

In ascending the river from its mouth, the first bridge across it is the road-bridge between Newburyport and Salisbury, and the second the railroad-bridge of the Eastern Railroad Company; these two bridges are so near together that the draw-ways are connected by a continuous draw-pier and the passage-way through each bridge is about seventy feet in width. The draws and abutment-piers are in good condition. The plan and alignment of the connecting draw-pier, however, are not as well arranged for the passage of vessels through the bridges as the general location will admit. Owing to unsettled questions of obligation on the part of the city of Newburyport and the Eastern Railroad Company, this draw-pier has never been completed.

The third bridge in order across the river is the chain bridge, so called, between Newburyport and Salisbury. This bridge consists of two parts, — one a chain suspension bridge between the Newburyport shore and Deer Island; and the other, between Deer Island and the Salisbury shore, is composed of a wooden girder with arched lower chord next to Deer Island, and beyond it a leaf-draw and two short spans crossed by simple trusses.

The chain bridge is well built and in good repair, and the channel under it is used by steamers and other mast-less craft in preference to the draw-way opening.

The piers in the other part of the bridge are poorly designed, poorly built, and out of repair, being unnecessarily wide with square ends presented to the current, which create strong eddies in both the flood and ebb tides which set strongly against the southerly side of the draw-way so that the passage through it is difficult. The piers consist of a foundation of crib-work up to about high-water mark; and resting upon these is light trestle-work up to the level of the bridge and extending a short distance on either side of the draw to serve as draw-piers, but is not high enough to be

of the best service, and is much out of repair, and slowly pressing into and narrowing the draw-way which has now a least available width of about 38 feet. The sheathing on the sides of the draw-way is also in bad condition and insufficient.

The abutments and superstructure of this part of the bridge are in good condition, and apparently require only ordinary repairs.

The fourth bridge is "Rocks Bridge," so called, between Haverhill and West Newbury. This bridge has four fixed spans and a draw-span, which are supported by two abutments and four piers. The piers are built of dimension granite resting on timber cribs filled with stone. The masonry of the piers is in generally good condition; but the timber of the cribs is considerably worn and broken, and in its present state liable to be damaged by ice, although it may stand some years without material injury, depending on the character of the winter and the manner in which the ice breaks up in the spring.

The superstructure of this bridge is somewhat out of repair in places; the trusses are bent or buckled, and not capable of sustaining as much weight as they should; but with moderate repairs and ordinary travel it may last for a number of years. The draw-span is a common leaf-draw, with a least width of 31.8 feet, in good repair, and is situated at the easterly end of the first span on the Haverhill side of the river, and on the westerly side of the channel. The flood-tide sets diagonally across the draw-way so that vessels are carried against the pier on the westerly side of the opening. Their passage through the draw-way might be facilitated, however, by draw-piers on either side of the bridge on the westerly side of the draw-way.

If the draw-way is widened, it should be located in the span next east of the present site, which would be nearer the centre of the river and current, and have an equal depth of water.

Groveland Bridge is the next in order, and is now in process of rebuilding. It is proposed to locate the draw-way in the middle of the channel, and to have it about sixty feet wide. When this bridge is complete it will be one of the best structures on the river. No other changes of plan are

necessary for further facility to navigation than already provided.

The draws in some of the bridges above referred to have been reported by parties, more particularly interested in steamboat-navigation, as not being of sufficient height above the level of the water to enable certain classes of steamboats to pass freely under them, which is considered a desirable facility of navigation, and it certainly is so where it can be practicably effected. But when a bridge is provided with a suitable draw which can be opened readily for the passage of all vessels which cannot pass under it, it seems like imposing a double burden to require a height of structure which would involve undue expense, or which would be out of proportion or adjustment, so to speak, with the approaches to and character of the respective shores of the river between which it crosses.

The relative burden upon the respective cities and towns in whose jurisdiction these bridges belong, of the expense of keeping them in repair and from time to time adapting them to improved and progressive modes of navigation, as compared with the importance and value to commerce and the public of the repairs and improvements requisite, is the problem to be solved in determining the improvements to be made. While the facilities afforded by these bridges of communication between the cities and towns bordering upon and near the river may have a beneficial public influence extending beyond their immediate locality, they have not the capacity nor the function of the waters of the river as a medium of communication and transportation which is almost limitless in its range and power. One instance of its value in this respect is the conveyance in one steamboat, in one summer season only, of thirty thousand persons from interior localities to the sea-beach for health and recreation.

The value of commercial transportation has also been recognized by the General Government in the liberal appropriations made and the laborious work done to improve the navigation of the river, the efficiency and even *possibility* of which is gauged by the capacity of the passage-ways through the bridges which cross its channels. These channels were a *first right of way*; and no restriction or interference with this right should be permitted or continued which is not of equivalent public value and advantage.

In view of the facts and circumstances which the Board have been able to ascertain in relation to the subject referred to them for investigation, they submit the following conclusions : —

First, The draw-way opening and draw in the part of the "Chain Bridge" between Deer Island and the Salisbury shore should be rebuilt and widened so as to give a clear passage-way of not less than fifty feet. In making the necessary alterations to effect this change, the lower members of the draw should be made as high above the water-level of the river as can be practicably accomplished without involving too radical a change in other features of the bridge. Suitable draw-piers should be built on either side of the bridge, and other modern appliances provided for the safe and convenient passage of vessels through the draw-way.

Second, The draw-way and draw in "Rocks Bridge" should be rebuilt at least fifty feet wide, and located in the span next east of the one in which it now is. The lower members of the draw should also be made as high as practicable above the water-level of the river. Suitable draw-piers and other appliances should be provided as for the other bridge.

Third, The draw pier between and connecting the city and railroad bridges at Newburyport should be completed, and such changes made in its alignment as will best secure the safe and convenient passage of vessels through these two bridges, which must be done by one operation while both of the draws are open.

VINEYARD HAVEN HARBOR.

At the request of citizens of Vineyard Haven, and after the conclusion by the Board of its expediency, a re-survey of portions of the harbor was made by the engineer during the last summer as a means of comparison with former observations, and to show what changes, if any, had taken place in the harbor. The results did not show the changes which local observers had anticipated in the general condition of the harbor. The anxiety manifested, however, by those continually observing it, is but the renewal of the subject of its value and the importance of some adequate means for the protection of the thousands of vessels which seek its anchorage grounds. This matter in the logic of events must sooner

or later receive the practical attention of the General Government. We need hardly reiterate the fact that the geographical position and peculiar surroundings of this harbor make it one of the most remarkable roadsteads, not only within the limits of this Commonwealth but in the whole range of the Atlantic coast of the United States. Its proximity to the pathway of the immense coastwise fleet which night and day continually pass its headlands, its accessibility in all winds and weather, and being at the threshold, as it were, of the dangerous region of fog and shoals which characterize the navigation around Cape Cod, make its value as a refuge almost beyond estimate. It is excellent in all the conditions of a roadstead save one, — that of exposure to the north-east. The correction of this defect, which is a practicable one, is the improvement and protection needed to make it one of the most useful harbors of the world.

BOUNDARY-LINES BETWEEN CITIES AND TOWNS BORDERING UPON THE SEA.

By chap. 196 of the Acts of 1881 the Board was directed to locate and define the courses of the boundary-lines between adjacent cities and towns bordering upon the sea, and upon arms of the sea, from high-water mark outward to the line of the Commonwealth as defined by sect. 1 of chap. 1 of the Revised Statutes; and to file a report of their doings, with suitable plans and exhibits, showing the boundary-lines of any town by them located and defined, in certain specified places.

So much of sect. 1 chap. 1 of the Revised Statutes, as refers to the extension of the boundary-lines between cities and towns bordering upon the sea, to the line of the Commonwealth, is as follows: "The territorial limits of this Commonwealth extend one marine league from its seashore at low-water mark. When an inlet or arm of the sea does not exceed two marine leagues in width, between headlands, a straight line from one headland to the other is equivalent to the shore-line."

It was quite impracticable for the Board to make original surveys, or prepare original plans upon which to show the lines to be located and defined, according to the act directing that work to be done; and no survey of limited scope

or means which they could make would have been so well adapted to the purposes required as the elaborate and accurate ones of the United States Coast and Geodetic Survey. The system upon which these maps are made affords the particular data desired in locating and describing the initial points in the line of State jurisdiction, which it is important to define in order to locate the points of intersection with it, or the termination at it of the boundary-lines between respective cities and towns. The details of coast topography upon these government maps also afford data for determining the points upon the shore where boundary-lines on land terminate. The maps selected are classed and entitled "Coast Charts Nos. 11, 12, and 13, coast of the United States," "Coast Charts Nos. 9 and 10, Massachusetts Bay," and "Coast Chart No. 8, from Wells to Cape Ann." The first three in one sheet include the line of the Commonwealth from the boundary with Rhode Island to Chatham on Cape Cod, the second two in one sheet the line of the Commonwealth from Chatham to the Dry Salvages on Cape Ann, and the third from the Dry Salvages to the boundary with New Hampshire.

The Board has found the duty imposed upon them one of peculiar interest; and, so far as they are aware, it is the first instance of such action being taken, and such illustrated determination of the limits of territorial jurisdiction being made, by any State bordering upon the sea. The work has proved to be more exacting than at first supposed, and will require more time and means to complete than was originally estimated. In examining the records, markings, and geographical peculiarities of the various terminal points of the boundary-lines between cities and towns upon the shore, it has been found necessary to visit the locality of nearly every terminal point so far considered, in order to ascertain the nature and particulars of each, whether on land and marked by monument, or whether in the mouth of some channel, bay, or creek. These have been conditions and facts necessary to determine, before the study of the extension of any given boundary-line to the line of the Commonwealth could be made and projected upon the plan. In some cases the Board has found difficulty in determining these bases for locating and defining the courses of respec-

tive boundary-lines. Two cases, those between Provincetown and Truro, and between Sandwich and Wareham, have presented questions of so much import as to require public hearings, and, in the case of Sandwich and Wareham, the action of learned counsel on either side. In this latter case the Board has held hearings at the location of the line, and in the office of the Board at Boston.

It has been found impracticable, within the past appropriate season, to do more than examine the series of boundary-lines between the towns in the peninsular portion of Cape Cod, from and including the boundary-line before mentioned, between Sandwich and Wareham, and Provincetown at the east and Gosnold at the west end of the Cape. The Board has projected, upon the maps referred to, the line of the Commonwealth. The position of the initial points, or points of deflection, in this line of the Commonwealth, are plotted to single seconds of latitude and longitude, which is as near as the scale of the maps will accurately exhibit. These positions can be reproduced upon any map of the Coast Survey, of any scale, and can be found upon the ground or water, by instrumental observation, by any competent engineer or surveyor. The limit of error or indefiniteness in the exact position of each point will not exceed a mean difference of about twenty-seven metres, equal to about twenty-nine yards. When it is considered that these points represent positions on the ocean, not less than three marine leagues from the nearest land, this location of a point is sufficiently represented for all practicable purposes. The maps on which the line is plotted are based upon a polyconic projection on a scale of $\frac{1}{80000}$, whereon each fifth minute of latitude and longitude is drawn.

LINE OF THE COMMONWEALTH.

The line of the Commonwealth begins at a point marked A on plan No. 3, which is comprised of the United States Coast and Geodetic Survey "Coast Charts Nos. 11, 12, and 13," in lat. $41^{\circ} 25' 05''$, long. $71^{\circ} 05' 28''$, distant one marine league from the shore-line, which is a line from the headland at Warren's Point in Rhode Island to the headland at Gooseberry Neck in Massachusetts, and runs easterly, parallel to the last-named line, to a point marked B on plan, in lat. $41^{\circ} 25' 25''$, long. $71^{\circ} 03' 16''$.

Thence south-easterly, parallel to and distant one marine league from a line from the said headland at Gooseberry Neck to the headland at the south-westerly point of the island of Cuttyhunk, to a point marked C on plan, in lat. $41^{\circ} 22' 23''$, long. $70^{\circ} 59' 33''$.

Thence south-easterly, on the arc of a circle of one marine league radius, from the said headland at Cuttyhunk to a point marked D on plan, in lat. $41^{\circ} 21' 55''$, long. $70^{\circ} 58' 50''$.

Thence south-easterly, parallel to and distant one marine league from a line from said headland at Cuttyhunk to the headland at the north-westerly point of Gay Head on the island of Martha's Vineyard, to a point marked E on plan, in lat. $41^{\circ} 19' 30''$, long. $70^{\circ} 53' 55''$.

Thence southerly, parallel to and distant one marine league from a line from the said headland at Gay Head to the headland at the westerly point of the island of No Man's Land, to a point marked F on plan, in lat. $41^{\circ} 15' 17''$, long. $70^{\circ} 53' 32''$.

Thence south-easterly, easterly, and north-easterly, on a curved line parallel to and distant one marine league from the general curve of the southerly shore-line of said No Man's Land, to a point marked G on plan, in lat. $41^{\circ} 13' 32''$, long. $70^{\circ} 44' 15''$.

Thence north-easterly, parallel to and distant one marine league from a line from the south-easterly headland of said No Man's Land to the south-easterly headland of Squipnocket on said Martha's Vineyard, to a point marked H on plan, in lat. $41^{\circ} 16' 18''$, long. $70^{\circ} 42' 26''$.

Thence north-easterly, parallel to and distant one marine league from a line from said headland at Squipnocket to the headland at the easterly end of Nashaquitsa Cliff on said Martha's Vineyard, to a point, marked I on plan, in lat. $41^{\circ} 17' 25''$, long. $70^{\circ} 40' 48''$.

Thence easterly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line of said Martha's Vineyard, to a point marked K on plan, in lat. $41^{\circ} 17' 45''$, long. $70^{\circ} 35' 30''$.

Thence easterly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line on said Martha's Vineyard, to a point marked L on plan, in lat. $41^{\circ} 17' 35''$, long. $70^{\circ} 26' 43''$.

Thence easterly, a little southerly, parallel to and distant one marine league from a line from the south-easterly headland of the island of Chappaquiddick to the headland at the south-easterly point of the island of Muskeget, to a point marked L^1 , in lat. $41^\circ 16' 34''$, long. $70^\circ 21' 30''$.

Thence south-easterly, on the arc of a circle of one marine league radius from the southerly Sand Island between the said island of Muskeget and the island of Tuckernuck, to a point marked M on plan, in lat. $41^\circ 15' 46''$, long. $70^\circ 20' 10''$.

Thence south-easterly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line of the southerly shore of the island of Nantucket, to a point marked M^1 on plan, in lat. $41^\circ 11' 20''$, long. $70^\circ 06' 55''$.

Thence easterly, parallel to and distant one marine league from a line from the headland opposite Miacomet Pond to Tom Never's Head on said Nantucket, to a point marked M^2 on plan, in lat. $41^\circ 11' 06''$, long. $70^\circ 00' 30''$.

Thence easterly and some northerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line of said Nantucket, to a point south-east of the south-easterly headland at Siasconsett, marked M^3 on plan, in lat. $41^\circ 12' 30''$, long. $69^\circ 55' 15''$.

Thence north-easterly and northerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line of said Nantucket, to a point east of the light-house at Sankaty Head, marked M^4 on plan, in lat. $41^\circ 16' 55''$, long. $69^\circ 53' 15''$.

Thence north-westerly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line of said Nantucket, to a point north-easterly from the northerly headland at Great Point, marked M^5 on plan, in lat. $41^\circ 25' 55''$, long. $69^\circ 59' 55''$.

Thence north-westerly, westerly, and south-westerly, on the arc of a circle of one marine league radius from said headland at Great Point, to a point marked M^6 on plan, in lat. $41^\circ 24' 26''$, long. $70^\circ 06' 27''$.

Thence southerly and some westerly, parallel to and distant one marine league from a line from said headland at Great Point to the headland at the south-westerly point of

Coatuc Beach, to a point marked M⁷ on plan, in lat. $41^{\circ} 20' 39''$, long. $70^{\circ} 07' 47''$.

Thence westerly, parallel to and distant one marine league from a line from said headland at Coatuc Beach to the headland opposite the north-easterly cove of Matacut Harbor, to a point marked M⁸ on plan, in lat. $41^{\circ} 20' 38''$, long. $70^{\circ} 10' 10''$.

Thence north-easterly, parallel to and distant one marine league from the line from said headland near Matacut Harbor to the headland at the easterly point of Muskeget Island, to a point marked M⁹ on plan, in lat. $41^{\circ} 22' 44''$, long. $70^{\circ} 15' 24''$.

Thence westerly and southerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line of the northerly side of said Muskeget Island, to a point marked M¹⁰ on plan, in lat. $41^{\circ} 23' 15''$, long. $70^{\circ} 19' 15''$.

Thence north-westerly, parallel to and distant one marine league from a line from the headland at the north-westerly point of said Muskeget Island to the headland opposite the south-easterly cove of Cape Poge Bay on the said Chappaquiddick Island, to a point marked N on plan, in lat. $41^{\circ} 24' 40''$, long. $70^{\circ} 22' 32''$.

Thence northerly and north-westerly, partly on a curved line and partly on the arc of a circle distant one marine league and radius one marine league from the shore-line and headland at the north-easterly point of said Cape Poge, to a point marked O on plan, in lat. $41^{\circ} 27' 53''$, long. $70^{\circ} 24' 35''$.

Thence north-westerly, parallel to and distant one marine league from a line from said headland at Cape Poge to the headland at the northerly point of the East Chop of Vineyard Haven, on said Martha's Vineyard, to a point marked P on plan, in lat. $41^{\circ} 29' 11''$, long. $70^{\circ} 27' 38''$.

Thence north-easterly, parallel to and distant one marine league from a line from said headland at East Chop to the headland between Waquoit and Popponessett Bays on the main shore, to a point marked Q on plan, in lat. $41^{\circ} 30' 53''$, long. $70^{\circ} 25' 55''$.

Thence north-easterly, parallel to and distant one marine league from a line from said last-named headland to the

headland opposite the south-easterly cove of Oysterville Harbor, to a point marked R on plan, in lat. $41^{\circ} 33' 23''$, long. $70^{\circ} 21' 34''$.

Thence easterly, parallel to and distant one marine league from a line from the said headland at Oysterville to the headland at Point Gammon, to a point marked S on plan, in lat. $41^{\circ} 33' 18''$, long. $70^{\circ} 15' 35$.

Thence easterly, on the arc of a circle of one marine league radius from said headland at Point Gammon, to a point marked T on plan, in lat. $41^{\circ} 33' 31'$, long. $70^{\circ} 14' 11''$.

Thence north-easterly, parallel to and distant one marine league from a line from said headland at Point Gammon to the headland on the east side of Swan Pond River, to a point marked U on plan, in lat. $41^{\circ} 36' 01''$, long. $70^{\circ} 06' 55''$.

Thence north-easterly, parallel to and distant one marine league from a line from said headland near Swan Pond River to the headland near Red River, to a point marked V on plan, in lat. $41^{\circ} 36' 30''$, long. $70^{\circ} 03' 45''$.

Thence southerly, parallel to and distant one marine league from a line from the headland at Inward Point on Monomay Island to the headland at the southerly point of said Monomay Island, to a point marked W on plan, in lat. $41^{\circ} 33' 07''$, long. $70^{\circ} 04' 30''$.

Thence southerly, south-easterly, and easterly, on the arc of a circle of one marine league radius from said headland at Monomay to a point marked W on plan, in lat. $41^{\circ} 30' 12''$, long. $69^{\circ} 58' 05''$.

Thence north-easterly, on a curved line parallel to and one marine league distant from the general curve of the shoreline of Monomay Island, to a point marked X on plan, in lat. $41^{\circ} 32' 17''$, long. $69^{\circ} 55' 21''$.

Thence northerly, a little easterly, parallel to and distant one marine league from the line from the headland near Monomay Light-house to the headland opposite Rump Hole on said Monomay Island, to a point marked Y on plan, in lat. $41^{\circ} 36' 42''$, long. $69^{\circ} 52' 58''$.

Thence north, a little easterly, parallel to and distant one marine league from a line from the said headland near Rump Hole to the headland opposite Morris Island, to a point marked Y¹ on plan, in lat. $41^{\circ} 38' 06''$, long. $69^{\circ} 52' 20''$.

Thence northerly, a little easterly, parallel to and distant

one marine league from a line from the said headland near Morris Island to the headland near Allen's Point on Nausett Beach, to a point marked Z on plan, in lat. $41^{\circ} 42' 31''$, long. $69^{\circ} 51' 05''$.

Thence northerly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked A² on plan, which is identical with the point marked A on plan No. 2 comprised of the United States Coast and Geodetic Survey "Coast Charts No. 9 and 10," in lat. $41^{\circ} 49' 02''$, long. $69^{\circ} 51' 55''$.

Thence north, a little easterly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked B on said plan No. 2, in lat. $41^{\circ} 53' 40''$, long. $69^{\circ} 53' 12''$.

Thence north, a little westerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked B¹ on plan, in lat. $41^{\circ} 59' 18''$, long. $69^{\circ} 55' 50''$.

Thence north, more westerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked C on plan, in lat. $42^{\circ} 04' 33''$, long. $70^{\circ} 00' 20''$.

Thence north-westerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked C¹ on plan, in lat. $42^{\circ} 07' 32''$, long. $70^{\circ} 08' 00''$.

Thence westerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked D on plan, in lat. $42^{\circ} 07' 34''$, long. $70^{\circ} 14' 15''$.

Thence south-westerly and southerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked D¹ on plan, in lat. $42^{\circ} 03' 42''$, long. $70^{\circ} 18' 22''$.

Thence south-easterly, partly on a curved and partly on a straight line parallel to and distant one marine league from the general curve and trend of the shore-line, to a point marked E on plan, in lat. $41^{\circ} 58' 57''$, long. $70^{\circ} 14' 01''$.

Thence south-easterly, parallel to and distant one marine league from a line from the headland at Wood End to the headland at Boundbrook Island, to a point marked F on plan, in lat. $41^{\circ} 55' 01''$, long. $70^{\circ} 08' 27''$.

Thence southerly, parallel to and distant one marine league from a line from the said headland at Boundbrook Island to the headland at the southerly end of Great Beach Hill, to a point marked G on plan, in lat. $41^{\circ} 53' 10''$, long. $70^{\circ} 08' 26''$.

Thence southerly, parallel to and distant one marine league from a line from said headland at Great Beach Hill to the headland at Billingsgate Island, to a point marked H on plan, in lat. $41^{\circ} 51' 40''$, long. $70^{\circ} 08' 08''$.

Thence southerly, parallel to and distant one marine league from a line from said headland at Billingsgate Island to the headland near the village of Brewster, to a point marked I on plan, in lat. $41^{\circ} 48' 38''$, long. $70^{\circ} 08' 39''$.

Thence westerly, a little southerly, parallel to and distant one marine league from a line from said headland near Brewster to the headland on Beach Point, to a point marked K on plan, in lat. $41^{\circ} 47' 18''$, long. $70^{\circ} 16' 38''$.

Thence westerly, parallel to and distant one marine league from a line from said headland at Beach Point to the headland near Scorton Neck, to a point marked L on plan, in lat. $41^{\circ} 47' 31''$, long. $70^{\circ} 22' 54''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland near Scorton Neck, to the headland at Scusset Beach, to a point marked M on plan, in lat. $41^{\circ} 49' 26''$, long. $70^{\circ} 27' 03''$.

Thence northerly, parallel to and distant one marine league from a line from the said headland at Scusset Beach to the headland at Centre Hill Point, to a point marked N on plan, in lat. $41^{\circ} 51' 50''$, long. $70^{\circ} 27' 08''$.

Thence northerly, a little westerly, parallel to and distant one marine league from a line from the said headland at Centre Hill Point to the headland at Manomet Point, to a point marked O on plan, in lat. $41^{\circ} 56' 09''$, long. $70^{\circ} 27' 56''$.

Thence south-westerly, on the arc of a circle of one marine league radius from said headland at Manomet Point, to a point marked P on plan, in lat. $41^{\circ} 57' 10''$, long. $70^{\circ} 28' 23''$.

Thence north-westerly, parallel to and distant one marine league from a line from said headland at Manomet Point to the headland at Gurnet Point, to a point marked Q on plan, in lat. $42^{\circ} 01' 40''$, long. $70^{\circ} 31' 59''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland at Gurnet Point

to the headland at Brant Rocks, to a point marked R on plan, in lat. $42^{\circ} 06' 34''$, long. $70^{\circ} 34' 23''$.

Thence north-easterly, on the arc of a circle of one marine league radius from said headland at Brant Rocks, to a point marked S on plan, in lat. $42^{\circ} 07' 17''$, long. $70^{\circ} 34' 53''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland at Brant Rocks to the headland near North River, to a point marked T on plan, in lat. $42^{\circ} 10' 00''$, long. $70^{\circ} 37' 35''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland near North River to the headland at Scituate Harbor, to a point marked U on plan, in lat. $42^{\circ} 13' 26''$, long. $70^{\circ} 38' 53''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland at Scituate Harbor to the headland at Minot's Ledge, to a point marked V on plan, in lat. $42^{\circ} 17' 32''$, long. $70^{\circ} 41' 38''$.

Thence north-westerly, on the arc of a circle of one marine league radius from the said headland at Minot's Ledge, to a point marked W on plan, in lat. $42^{\circ} 18' 53''$, long. $70^{\circ} 43' 33''$.

Thence north, more westerly, parallel to and distant one marine league from a line from the said headland at Minot's Ledge to the headland at Point Allerton, to a point marked X on plan, in lat. $42^{\circ} 20' 20''$, long. $70^{\circ} 48' 00''$.

Thence north, a little easterly, parallel to and distant one marine league from a line from the said headland at Point Allerton to the headland at the North-east Graves, to a point marked Y on plan, in lat. $42^{\circ} 21' 46''$, long. $70^{\circ} 47' 38''$.

Thence north, a little easterly, parallel to and distant one marine league from a line from the said headland at North-east Graves to the headland at Great Pig Rocks, to a point marked Z on plan, in lat. $42^{\circ} 26' 20''$, long. $70^{\circ} 46' 58''$.

Thence north-easterly, parallel to and distant one marine league from a line from the said headland at Great Pig Rocks to the headland at Inner Breaker, to a point marked Z¹ on plan, in lat. $42^{\circ} 29' 00''$, long. $70^{\circ} 43' 22''$.

Thence north-easterly, parallel to and distant one marine league from a line from the said headland at Inner Breaker to the headland at Eastern Point, to a point marked Z² on plan, in lat. $42^{\circ} 32' 18''$, long. $70^{\circ} 36' 59''$.

Thence north-easterly, on a slightly curved line parallel

to and distant one marine league from the general curve of the southerly shore-line of Eastern Point, to a point marked Z^3 on plan, in lat. $42^\circ 32' 37''$, long. $70^\circ 36' 17''$.

Thence north-easterly, parallel to and distant one marine league from a line from the headland on the southerly shore of Eastern Point to the headland at Londoner, to a point marked Z^4 on plan, in lat. $42^\circ 35' 45''$, long. $70^\circ 31' 00''$.

Thence north-easterly and northerly, on the arc of a circle of one marine league radius from the said headland at Londoner, to a point marked Z^5 on plan, in lat. $42^\circ 38' 06''$, long. $70^\circ 29' 34''$.

Thence northerly, parallel to and distant one marine league from a line from the said headland at Londoner to the headland at Dry Salvages, to a point marked Z^6 on plan, in lat. $42^\circ 40' 26''$, long. $70^\circ 29' 40''$.

Thence northerly and north-westerly, on the arc of a circle of one marine league radius from said headland at Dry Salvages, to a point marked Z^7 on plan, which is identical with a point marked A on plan No. 1 comprised of the United States Coast Survey "Chart No. 8 from Wells to Cape Ann," in lat. $42^\circ 43' 04''$, long. $70^\circ 32' 09''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland at Dry Salvages to the headland at Halibut Point, marked B on said plan No. 1, in lat. $42^\circ 44' 15''$, long. $70^\circ 35' 53''$.

Thence westerly, on the arc of a circle of one marine league radius from the said headland at Halibut Point, to a point marked C on plan, in lat. $42^\circ 44' 25''$, long. $70^\circ 38' 30''$.

Thence westerly, a little northerly, parallel to and distant one marine league from a line from a headland near the said Halibut Point to the headland at the southerly end of Plum Island, to a point marked D on plan, in lat. $42^\circ 45' 02''$, long. $70^\circ 42' 43''$.

Thence northerly, a little westerly, parallel to and distant one marine league from a line from the said headland at the southerly end of Plum Island to the headland near the mouth of Merrimack River, to a point marked E on plan, in lat. $42^\circ 48' 25''$, long. $70^\circ 43' 52''$.

Thence northerly, a little easterly, parallel to and distant one marine league from the said headland near the mouth of Merrimack River to the headland at Old Cellar Rock, to a

point marked F on plan, the northerly terminus of the line, in lat. $42^{\circ} 51' 55''$, long. $70^{\circ} 43' 26''$.

The linear extent of the line of the Commonwealth, in its course as above defined, around the islands of Martha's Vineyard and Nantucket, and around Cape Cod and Cape Ann from the point of boundary with the State of Rhode Island to the south-easterly point of Nantucket, is about 75 miles; to the southerly point of Monomay, about 158 miles; to the northerly point of Cape Cod at Race Point, about 222 miles; to the entrance of Boston Harbor, about 304 miles; to the easterly point of Cape Ann, about 336 miles; and to the northerly terminus of the line of the Commonwealth at its boundary with New Hampshire, about 355 miles.

The distance from the southerly terminus of the line of the Commonwealth at its boundary with Rhode Island to the southerly point of Monomay following the line of the Commonwealth and the line of boundary between the towns bordering on Vineyard Sound, is about 71 miles.

HARBOR IMPROVEMENTS BY THE GENERAL GOVERNMENT.

Boston Harbor.

The works of the General Government in the harbors of the State during the past year have been continued with increasing advantages to its commerce. The opportunities which the Board have had to observe the character and progress of this work make it gratifying as well as incumbent upon them to call attention to the long and interested service which the engineer officers of the United States in charge of it have rendered to the Commonwealth, and the value of their personal and professional experience in examinations and estimates, and in the execution of the varied and difficult projects of improvement submitted to their care. The Board is indebted to both Gen. Thom and Gen. Warren for the continued courtesy of information concerning their respective works.

In the northern division of the seacoast of the State, in charge of Gen. George Thom, United States engineer, the work done in Boston Harbor has been the important one of removing "Anchorage Shoal," in the main basin of the upper

harbor. 47,224 cubic yards have been dredged, which has added 225 feet to the width of the main channel, the aggregate of which is now about 770 feet. By the early part of March the width will be still further increased to about 810 feet, and by the end of next November the full projected width of the channel will be effected. The Board hope, however, that the development of the harbor has reached a point which will induce the General Government to revise its project for the improvement of the main channel so as to increase materially the minimum width heretofore contemplated.

In execution of the project for the improvement of Charles River, from its mouth to the dam at the head of tide-water at Watertown, 63,000 cubic yards of dredging has been done, and the improvement of the channel completed, from the mouth of the river to Western-avenue Bridge, a distance of about $4\frac{1}{2}$ miles.

At the mouth of the Mystic River 48,343 cubic yards of dredging has been done, which has increased the width of the channel by 125 feet, making its total average width 250 feet. Still further work of excavation has been begun, to be completed the coming season, which will complete the project of improvement for this river.

Repairs have been made, where most necessary, on the sea-walls of Lovell's Island, Long Island, and Deer Island.

21,924 cubic yards of dredging has been done in Nantasket Beach channel, which has opened the channel to a width of about 70 feet, and a depth at mean low water of $9\frac{1}{2}$ feet.

In order to complete all the works now projected for the improvement of Boston Harbor, the following appropriations have been asked for: to wit, —

Widening main ship channel at Upper Middle, at its westerly end, and for rebuilding and repairing sea-walls in Boston Harbor proper		\$24,000
Completing improvement of Charles River		67,500
Completing channel leading to Nantasket Beach		5,000
		\$96,500

Merrimack River.

The improvement of the Merrimack River is a work of much importance, particularly to the citizens of the north-eastern portion of the State. The increased facilities given to all

classes of navigation by the aid of the General Government, and the improvement of the draw-way openings through the various bridges, will give a character and value to the river not heretofore possessed. As stated by Gen. Thom, the object of the present project for the improvement of this river is to afford a channel of navigable width and a depth of not less than nine feet at mean low water from its mouth at the outlet of Newburyport Harbor up to Deer Island Bridge,—a distance of about five miles; and thence up to Haverhill Bridge,—an additional distance of $12\frac{1}{2}$ miles, with a depth of twelve feet at ordinary *high water*, the rise and fall of tides varying from seven and a half to four feet; and thence up to the head of the “Upper Falls,”—a distance of four miles, a depth of not less than four feet and a half in the ordinary stages of the river, with the mill-water at Lawrence running, the rise and fall of the tides varying from four feet at Haverhill to none at the foot of the “Upper Falls.”

The natural channel of this river was very narrow and crooked in several places, and much obstructed by sunken ledges, bowlders, and shoals, and especially at the falls, portions of which were covered with bowlders and ledges more or less bare, and impassable for any vessels or scows; whilst in Newburyport Harbor the channel was obstructed by numerous sunken ledges, crib-work piers, and wrecks, seriously endangering navigation. Previous to January, 1881, the work done for the improvement of this river consisted in opening the channel above Haverhill and through the falls to the projected width and depth in places where absolutely necessary to make its navigation practicable, also in dredging at Haverhill between the bridges, and at Silsby Island shoals, as well as at Currier's shoal, about four miles below Haverhill, including the removal of a large number of dangerous sunken rocks at and near Rocks Bridge and the head of Silsby Island; also in Newburyport Harbor in the removal of “Ganway Rock” and “North Rocks” in part, and in the removal of two sunken wrecks. During the past year the removal of “South Ganway Rock” in Newburyport Harbor to a depth of nine feet at mean low water has been completed, together with the breaking up and removal of North Rock spur to a depth of nine feet, and the breaking up and removal of South Badger ledge near the mouth of the river to ten feet at mean low water.

Newburyport Harbor.

The project of improvement for Newburyport Harbor was to afford a permanent channel through the outer bar, with a depth sufficient to allow vessels of 13½ feet draught to cross it at mean low water, the rise and fall of the tides being 7½ feet. To effect this, the project of two converging rubble-stone jetties has been adopted, to be built out from the shore at points north and south of the entrance to a height of four feet above mean high water, with a width of 15 feet on top, with inner slope of 45°, and outer slope of 22½°, the entrance through the outer extremities of the jetties to be 1,000 feet in width. The cost of these jetties is estimated at \$365,000. Work has already been done on the northern jetty by the placing of about 13,743 tons of stone, whereby the work has been built out for a distance of about 700 feet from Salisbury Beach.

Scituate Harbor.

A survey of Scituate Harbor was made by Gen. Thom in 1878, with a view to its adaptability as a harbor of refuge, and a project devised for two rubble-stone jetties to protect the entrance; also to excavate a basin inside of sufficient area for the harbor, with a depth of ten to twelve feet at mean low water, the greatest depth at present being not more than about five feet on a very small area; also to excavate a channel into the harbor, with a depth of not less than ten feet at mean low water. The estimated cost of this improvement as revised for the project adopted is \$280,000. \$17,500 of this amount has been appropriated, and during the last summer, after many interruptions caused by unfavorable weather, 5,088 tons of stone have been put in place.

Plymouth Harbor.

The existence of this harbor depends upon the protection and preservation of Long Beach, which has been under the care of the government engineers from 1864 to and including 1881, and \$84,800 in various sums have been appropriated for their work. In 1875 a channel was dredged fifty feet wide and six feet deep at mean low water, from the "middle ground" up to "Long Wharf,"—a distance of about 2,500 feet. The project of improvement, however, provides for a

channel 100 feet wide up to Long Wharf, and extended southward towards the mouth of Town Brook,—a distance of about 900 feet above Long Wharf,—so as to form a basin in front of the wharves of the city 150 feet in width and eight feet deep at mean low water. On the 1st of September, 1881, this project was entirely completed by the removal of 103,505 cubic yards of material from the channel and basin referred to. It is most gratifying to state that the only work that now remains to be done for the preservation and protection of this harbor consists in the repairs of the works on Long Beach where necessary.

Provincetown Harbor.

All the works projected for the protection, preservation, and improvement of this harbor have been completed, with the exception of the bulkheads on Long Point, which are in good condition, and fully answer the purposes designed. They will, however, require continual watching and occasional repairs.

Lynn Harbor.

A survey of Lynn Harbor has been made, with a view to its improvement, and a project and estimate for the respective work has been submitted to the Chief of Engineers to be laid before Congress.

Merrimack River, from Lawrence, Mass., to Manchester, N.H.

A survey, project, and estimate of cost for this part of the river—a distance of about forty-eight miles and a half—have been made, and submitted to the Chief of Engineers, to be laid before Congress.

GOVERNMENT WORK IN CHARGE OF GEN. G. K. WARREN.

The works of harbor improvement upon the southern coast of the State in charge of Gen. G. K. Warren, United States Engineers, are of much importance, particularly those of protection and improvement of the harbors of refuge in the dangerous navigation of this part of the coast.

Nantucket Harbor.

Up to the 30th of June last, nearly 4,000 tons of granite had been placed in the jetty on the westerly side of the

entrance to Nantucket Harbor, extending it 850 feet, and additional work has been done upon it since. Gen. Warren considers it too soon to see or predict the effect of the jetty in increasing the depth of water over the shoals; but careful and comprehensive surveys have been made as a basis for future comparison of changes following the construction of the jetty. Seventy-five thousand dollars is asked for the completion of this work by June 30, 1883.

Edgartown Harbor.

During the last summer a conference was held at Edgartown between Gen. G. K. Warren, the chairman of this Board, and the citizens of the port interested in the harbor, to discuss and devise means for its improvement.

With a small unexpended portion of a former government appropriation, to which the Board added the sum of \$300, a re-survey was made under the direction of Gen. Warren in order to ascertain and compare the changes which have taken place in various parts of the harbor since the closing of the south beach in 1869. Gen. Warren has taken renewed interest in the problem of re-establishing a southern inlet to this harbor; and, while there are many difficulties and uncertainties attending its accomplishment, he considers the possibilities of success sufficient to warrant another appropriation by the General Government for the required work.

Woods Holl.

The work of improvement in this important thoroughfare executed during the fiscal year ending June 30, 1881, consisted in removing bowlders of various sizes, and completing the work which had been in progress during the previous year. The original plan and estimate for the thorough improvement of this passage-way comprehended extensive excavations at a cost of \$430,000. The demand for this, however, does not seem to be immediate. Gen. Warren says, "This complete improvement may truly be called a national one. It is not for the benefit of any special locality. It is for a navigable highway uniting two large bodies of navigable water extensively used by the commercial vessels of the United States; and when thoroughly improved it will

tend greatly to a saving of time, and diminish the dangers of general coast navigation."

Taunton River.

Work has been executed for the improvement of Taunton River in conformity with previous plans and estimates, and a channel excavated eleven feet deep at mean high water, and from forty to sixty feet wide for a distance of 3,100 feet from the bridge at Weir down the river. An additional appropriation of \$25,000 has been made for continuing this improvement, and the amount estimated as necessary to complete the existing project to give an available depth of eleven feet at mean high water to Weir Bridge, is \$41,500.

Connecticut River.

The importance of the improvement of this river may be judged by the fact that after careful examination by the United States engineers, the amount estimated to complete existing projects is \$1,322,805. Satisfactory work has been done during the last year, and its continuance contemplated.

OFFICE AND FIELD WORK.

Plans approved and Licenses granted, during the Year 1881, for the Erection of Structures in and over Tide-Water.

Nos.

587. C. E. Stevenson, for leave to build a solid wharf on the south shore of Winthrop. Approved Jan. 13, 1881.
- 587½. Boston and Maine Railroad, for leave to rebuild its bridge across Merrimack River, between Bradford and Haverhill. Approved Jan. 20, 1881.
588. Killey E. Terry, for leave to construct a wharf on the west side of Clark's Cove, in the town of Dartmouth. Approved Jan. 20, 1881.
589. Old Colony Railroad Company, for leave to fill solid certain portions of its bridge on the line of its road across North River, in the towns of Marshfield and Scituate. Approved Jan. 20, 1881.
590. Hoosac Tunnel Dock and Elevator Company, for leave to extend its wharves (otherwise known as Damon's, Hittinger's, and Tudor's Wharves) on Charles River, Charlestown District. Approved Jan. 20, 1881.
591. Samuel Osborn, jun., and Walter S. Osborn, for leave to extend Osborn's Wharf, at Edgartown. Approved Feb. 3, 1881.
592. Boston and Albany Railroad Company, for leave to widen Pier No. 1, Grand Junction Wharves, East Boston. Approved Feb. 17, 1881.
593. P. E. Bowers, for leave to extend his wharf on Taunton River, in the town of Somerset. Approved Feb. 17, 1881.
594. The Boston Steamboat and Pier Company, for leave to construct a pile-pier on Cherry Island Bar, at Broad Sound Point, in the town of Revere. Approved March 17, 1881.
595. Moses Williams, for leave to straighten and widen the southerly side of India Wharf. Approved March 17, 1881.
596. City of Newburyport, for leave to construct a pile-structure for the purpose of giving greater safety to the first span in Newburyport Bridge. Approved March 25, 1881.
597. W. F. Whitney, for leave to extend his wharf on First Street, near F Street, South Boston. Approved March 31, 1881.
598. Hull and Nantasket Beach Railroad Company, for leave to construct a pile-wharf on the southerly side of Windmill Point, Hull. Approved March 31, 1881.
599. Forest Hill Company, for leave to build wharves and other structures on Taunton River, Fall River. Approved March 31, 1881.
600. Lyman R. Blake, for leave to construct a wharf on Charles Neck, town of Marion. Approved March 31, 1881.
601. J. H. and F. A. Langmaid, for leave to cover with a pile-structure part of their dock, Salem Harbor. Approved April 8, 1881.
602. O. F. Belcher, for leave to build a solid wharf on the south shore of Winthrop. Approved April 14, 1881.

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Nos.

603. Chelsea Beach Railroad Company, for leave to build a bridge across an inlet from Pines River, in the town of Revere. Approved April 20, 1881.
604. Forest Hill Company, for leave to build a pile-wharf in front of its premises on the easterly side of Taunton River, city of Fall River. Approved April 21, 1881.
605. Eastern Railroad Company, for leave to fill flats in Frye's Mill-pond, Salem. Approved April 28, 1881.
606. City of Salem, for leave to build a canal with stone walls, in Frye's Mill-pond. Approved April 28, 1881.
607. Hoosac Tunnel Dock and Elevator Company, for leave to drive additional piles for the support of sheds upon Hittinger's Wharf, Charlestown District. Approved April 28, 1881.
608. William Pickering, jun., for leave to build a stone wall upon his wharf on Union Street, Salem. Approved April 28, 1881.
609. City of Boston, for leave to rebuild and extend its wharf on Deer Island, Boston Harbor. Approved May 5, 1881.
- 609*. Central Wharf and Wet Dock Corporation, for leave to extend Central and India Wharves to the harbor line. Approved April 28, 1881.
610. Lyon, Depuy, and Co., for leave to rebuild and extend their wharf at East Boston. Approved May 19, 1881.
611. Hoosac Tunnel Dock and Elevator Company, for leave to extend its wharf, known as Gage's or Swett's Wharf, Charlestown District. Approved May 5, 1881.
612. Chelsea Beach Company, for leave to build a wharf at Pines Point, town of Revere. Approved May 26, 1881.
613. W. J. Humphrey, for leave to extend his wharf on Border Street, East Boston. Approved May 26, 1881.
614. Old Colony Railroad Company, for leave to extend its pile-wharf on Fort Point Channel, South Boston. Approved June 2, 1881.
615. Home for Aged Women, for leave to rebuild its sea-wall in front of its property bordering on Charles River, between Revere and Pinckney Streets. Approved June 16, 1881.
616. Eastern Railroad Company, for leave to widen and extend its wharf at East Boston. Approved June 3, 1881.
617. Edward P. Shaw, for leave to build a pile-pier on Merrimack River, near Salisbury Point. Approved June 13, 1881.
- 618 and 618*. Chelsea Beach Railroad Company, for leave to construct a bridge across Pines River, in the towns of Revere and Saugus. Approved July 2, 1881.
619. Boston Forge Company, for leave to extend its wharf on Maverick Street, East Boston. Approved July 7, 1881.
620. Chelsea Beach Company, for leave to erect a group of bathing-houses near Pines Point. Approved July 14, 1881.
621. S. S. Swift of Provincetown, for leave to construct a pile-wharf in Provincetown Harbor. Approved July 21, 1881.
622. William Hayes, for leave to build a sea-wall and fill flats at Stage Point, Salem Harbor. Approved July 21, 1881.

Nos.

623. Boston Steamboat and Pier Company, for leave to extend its pier on Cherry Island Bar, at Broad Sound Point, in the town of Revere. Approved July 28, 1881.
624. Beacon Oil Company, for leave to extend its wharf on Chelsea Creek, East Boston. Approved July 28, 1881.
625. William Hale, for leave to extend his wharf on Merrimack River, City of Haverhill. Approved Aug. 4, 1881.
626. Hoosac Tunnel Dock and Elevator Company, for leave to drive additional piles upon Damon's Wharf, Charlestown District, for the support of sheds. Approved Aug. 11, 1881.
627. Alford Butler, for leave to build a wharf on Mill Creek, town of Revere. Approved Aug. 11, 1881.
628. William E. Gutterson, for leave to extend his wharf on Fort Point Channel. Approved Aug. 11, 1881.
629. Hoosac Tunnel Dock and Elevator Company, for leave to drive additional piles upon easterly Tudor Wharf, for the support of sheds, Charlestown District. Approved Sept. 22, 1881.
630. David L. and John G. Webster, for leave to build a wharf on Malden River, Malden. Approved Sept. 22, 1881.
631. R. W. Bowles, for leave to construct a wharf in Mattapoisett Harbor. Approved Sept. 22, 1881.
632. Board of Health of the town of Hull, for leave to construct a sewer outlet at Windmill Point, town of Hull. Approved Sept. 22, 1881.
633. Town of Malden, for leave to change the direction of Malden River, and also to construct a bridge across said river. Approved Sept. 29, 1881.
634. Boston and Maine Railroad, for leave to reconstruct its bridge across Merrimack River, between Bradford and Haverhill. Approved Sept. 29, 1881.
635. City of Boston, for leave to widen the passage-ways for vessels through Mount Washington Avenue Bridge, in Fort Point Channel. Approved Oct. 6, 1881.
- 635*. Trustees under the will of William S. Perry, for leave to extend Perry's Wharf, on Fort Point Channel, near Broadway Bridge. Approved Sept. 29, 1881.
636. Old Colony Railroad Company, for leave to extend its steamboat wharf, in the city of Fall River. Approved Oct. 13, 1881.
637. Nantasket Company, for leave to reconstruct its embankments along the line of high-water mark, on the inside or westerly shore of Nantasket Long Beach. Approved Oct. 15, 1881.
638. Proprietors of Rowe's Wharf, for leave to widen and extend their wharf to the harbor line, in Fort Point Channel. Approved Oct. 13, 1881.
639. Boston and Roxbury Mill Corporation, for leave to fill flats in Charles River, near the Beacon entrance of the Back Bay Park. Approved Nov. 10, 1881.
640. Thomas H. Balch, for leave to construct a pile-pier on Merrimack River, in the town of Groveland. Approved Oct. 27, 1881.

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641. Charles B. Barnes, for leave to extend his wharf, known as Humphrey's Wharf, Hingham Harbor. Approved Nov. 10, 1881.
642. N. P. Merriam, for leave to construct a pile-wharf near the foot of River Street, on Porter's River, Danversport. Approved Nov. 10, 1881.
643. John C. Tilton, for leave to extend his wharf on Merrimack Street, in the city of Haverhill. Approved Nov. 10, 1881.
644. Trustees under the will of Ebenezer Francis, for leave to extend Francis Wharf, on Fort Point Channel. Approved Nov. 28, 1881.
645. John S. Weeks, for leave to change a portion of his wharf from pile to solid, on Border Street, East Boston. Approved Dec. 1, 1881.
646. N. E. Harlow, for leave to extend his wharf in Plymouth Harbor. Approved Dec. 3, 1881.
647. Jabez K. Montgomery and Atwood L. Howard, lessees of the United States Government Wharf at Chelsea, for leave to drive piles in front of said wharf, in Chelsea Creek. Approved Dec. 8, 1881.
648. Samuel Haskell, for leave to extend his wharf in Gloucester Harbor. Approved Dec. 29, 1881.
649. Benj. F. Allen and Daniel Allen, jun., for leave to extend their wharf on Five Pound Island, Gloucester Harbor. Approved Dec. 29, 1881.
650. Charles Smiley, for leave to extend his wharf on Merrimack River, city of Haverhill. Approved Dec. 29, 1881.

Sixty-seven licenses have been granted, which is above the yearly average, though not as many as were issued in 1880. About one-third of the licenses granted were for structures in Boston Harbor. The Board has endeavored to make the inspection of localities where the erection of structures has been proposed, more thorough and systematic, and has found the demands upon its time and that of its employés to increase.

ALBERT MASON.
FRANCIS A. NYE.
HENRY L. WHITING.

Boston, Jan. 1, 1882.

APPENDIX.

APPENDIX.

[1.]

Articles of Agreement made this Twenty-first Day of June, in the Year Eighteen Hundred and Eighty-one, by and between F. G. WHITCOMB of East Boston in the County of Suffolk and Commonwealth of Massachusetts, Party of the First Part, and the COMMONWEALTH OF MASSACHUSETTS, acting by its Board of Harbor and Land Commissioners, Party of the Second Part, witness:—

The said party of the first part hereby covenants and agrees with said party of the second part to furnish all the materials, and build fourteen hundred (1,400) feet of bulkhead in three lines, as follows: one thousand (1,000) feet to be one hundred (100) feet east of and parallel to the easterly line of D Street, two hundred (200) feet to be two hundred and fifty (250) feet east of and parallel to the easterly line of C Street, and two hundred (200) feet to be one hundred (100) feet west of and parallel to the westerly line of C Street; each line to commence about two hundred and twenty (220) feet north-easterly of First Street, and run north-easterly.

The bulkhead is to be built of spruce piles driven six feet apart on centres, with a spurshore to each pile; and the piles are to be planked from the surface of the mud to grade seven (7).

The plan on file at the office of the Harbor and Land Commissioners shows the details and method of construction of the bulkhead, and, is to be followed in details not otherwise mentioned.

The piles and spurshores shall be straight, and free from large knots, and not less than ten (10) inches diameter at the butt, and not less than six (6) inches diameter at the point when ready for driving. They are to be driven six (6) feet into the hard bottom, and all those injured by driving shall be removed and replaced by sound ones at the expense of the contractor.

The faces of the main piles must be brought to a true line before the planking is put on, the tops are to be cut off level at grade fourteen (14), and the spurshores are to be fitted at grade six and five-tenths (6.5); and each one will be bolted with one one-and-one-fourth-inch screw-bolt. The piles at the outer ends will be braced by two additional spurshores

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fitted at grade ten (10), and bolted with one-and-one-fourth-inch screw-bolts.

The planks are to be spruce, three (3) inches thick, sound, sawed square, and not less than twelve (12) feet long. They are to be secured to the piles by wrought-iron ship-spikes six inches long, and three-eighths inch square, and the butt-joints must come on the piles.

If required by the engineer, the planks must be still farther secured, as shown in red on the afore-mentioned plan.

All the work to be done in a neat and workmanlike manner, in accordance with the lines, grades, and instructions given by the engineer, and to the satisfaction of the commissioners and the engineer.

The work to be commenced within two weeks, and to be prosecuted continuously till its completion.

The said party of the second part hereby covenants and agrees with said party of the first part to pay said party of the first part for said bulkhead at the rate of one dollar and fifty-two cents (\$1.52) per lineal foot, and, in case said extra fastening is required, at the rate of one dollar and sixty-nine cents (\$1.69) per lineal foot for the part where said extra fastening is required.

Monthly estimates of the work done will be made by the engineer, and payment of ninety per cent of the contract-price will be made thereon, the remaining ten per cent to be retained until the completion, final measurement, and acceptance of the work.

It is agreed by and between the parties hereto that upon all questions of measurement, lines, or grades, the decision of the engineer of said board shall be final.

In testimony whereof the said F. G. Whitcomb has hereunto set his hand and seal, and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by its Board of Harbor and Land Commissioners the day and year above written, and the same to be approved by its Governor and Council.

F. G. WHITCOMB.

[SEAL]

COMMONWEALTH OF MASSACHUSETTS,

[SEAL OF THE
COMMONWEALTH.]

By ALBERT MASON,
WILL'D P. PHILLIPS,
F. A. NYE.

IN COUNCIL, June 25, 1881.

Approved.

HENRY B. PEIRCE,

Secretary.

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ASTOR, LENOX AND
TILDEN FOUNDATIONS.

PLAN
SHOWING LOCATION OF FLATS.
TO BE FILLED UNDER CONTRACTS
TO ACCOMPANY REPORT FOR
1881.

MAIN SHIP CHANNL.

FORT POINT CHANNL.

25
ACRE PARCEL.

BOSTON WHARF CO

50
ACRE PARCEL.

THOMAS POTTER

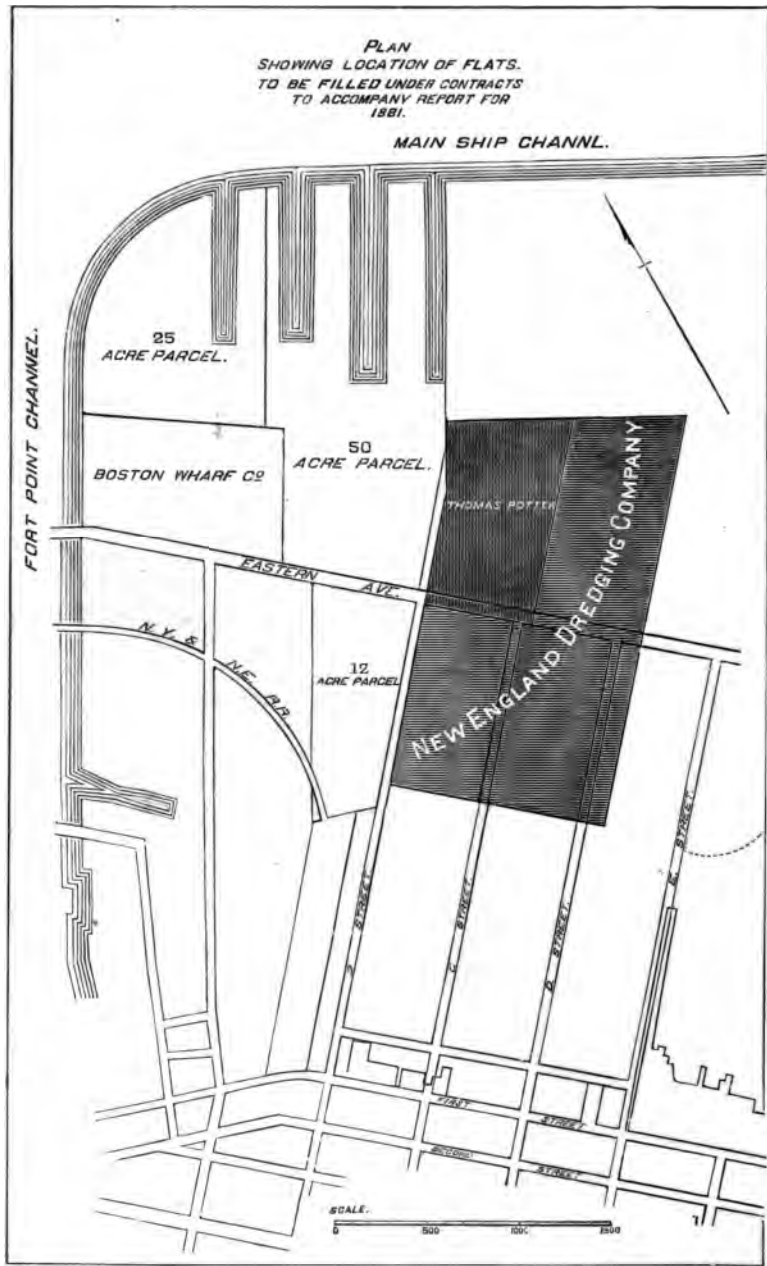
EASTERN AVE.

N.Y. &
N.E. RR.

12
ACRE PARCEL

NEW ENGLAND DREDGING COMPANY

SCALE.
0 500 1000 1500



[2.]

Articles of Agreement made this Twelfth Day of August, in the Year Eighteen Hundred and Eighty-one, by and between the NEW ENGLAND DREDGING COMPANY, a Corporation duly established under the Laws of Massachusetts, Party of the First Part, and the COMMONWEALTH OF MASSACHUSETTS acting by its Board of Harbor and Land Commissioners, Party of the Second Part, witness:—

The said party of the first part hereby covenants and agrees with said party of the second part:

First, to dredge five hundred thousand cubic yards of material from the shoals in the harbor of Boston, lying southerly of the main ship channel and north-westerly of slate ledge, at places to be designated by the engineer of the Board of Harbor and Land Commissioners, and to deposit said dredged material on the flats of said Commonwealth lying between B Street and a line one hundred feet east of and parallel with the easterly line of D Street, and between the southerly line of Eastern Avenue and a line about one thousand feet south of and parallel with the southerly line of Eastern Avenue.

Second, to dredge four hundred thousand cubic yards of material from the shoals in the harbor of Boston lying southerly of the main ship channel and north-westerly of slate ledge, and deposit the same on the flats of the Commonwealth lying between a line fifty feet east of and parallel with the easterly line of C Street extended, and a line one hundred feet east of and parallel with the easterly line of D Street extended, and between the southerly line of Eastern Avenue and a line one thousand three hundred feet south of and parallel with the exterior line of South Boston Flats, as shown on the plan hereto annexed. All the dredging shall be to the depth of twenty-three feet at mean low water, except at the mouth of Fort Point Channel, where the bottom shall be sloped up to meet the bottom, as now dredged, and excepting in case of ledge and of bowlders of more than one-half of one cubic yard. All areas dredged over shall be left smooth and regular at the required depths. If any portion of said dredged area is excavated deeper than twenty-five feet at mean low water, an amount of material equal to the amount excavated below grade minus 2½ shall, without expense to the Commonwealth, be excavated from and deposited by scows on such places on the flats as the engineer shall designate. The amount of the excavation will be determined by the measurement of the filling as hereinafter provided.

All the flats to be filled shall be filled from the present surface to grade 13, and at the completion of the work shall be left smooth and level at grade 13, where the boundaries of said filling are protected by other filling or by bulkheads. The filling shall be brought up to grade 13 at

such boundaries, but where the boundaries are unprotected the filling is to be allowed to take its natural slope.

In filling immediately behind a bulkhead, the filling must be deposited in such a manner that it will flow away from the bulkhead and not towards it.

In the work of both dredging and filling, the lines, grades, and instructions given by the engineer in charge must be strictly observed, and all necessary aid and material for giving said lines and grades shall be furnished by said party of the first part.

All the work shall be done to the reasonable satisfaction of the engineer at any time during the progress, and until the completion and acceptance, of the work.

The dredging and filling of the area first described shall be completed, and 175,000 cubic yards of the filling of the second described area shall be completed, within three years from the date of approval of this contract, and the whole 900,000 cubic yards shall be completed within four years from date of approval.

The work shall be commenced within a reasonable time, and prosecuted with the necessary vigor to insure its completion within the time herein stipulated.

The said party of the second part hereby covenants and agrees with said party of the first part to pay said party of the first part for excavating in the harbor, and filling the area described first, at the rate of fifty cents per cubic yard; and for excavating in the harbor, and filling the area described second, at the rate of forty-six cents per cubic yard; in the manner and upon the conditions herein set forth and agreed as follows: plans showing the present surface of the flats will be made by the engineer in charge before the filling is begun, and will be used as the basis of all measurements of filling. Monthly estimates of the work executed will be made by the engineer in charge, and payment will be made of seventy-five per cent of the contract price for all the material deposited below grade 5 and above grade 13, and ninety per cent of the contract price for all the material between grades 5 and 13.

When an area is graded level at grade 13, or at such grade as shall be thought necessary to allow for settling, payment will be made of ninety per cent of the contract price for all the material deposited on said area up to grade 13. The remaining ten per cent to be retained until the final completion and acceptance of the work.

When the area filled from one tramway has been levelled and maintained at grade 13 for one month, such area shall be accepted as to grade, and the contractor relieved of further care of the same.

It is agreed by and between the parties hereto, that upon all questions of measurement, lines or grades proposed in writing by one party and after notice to the other party, the decision of the engineer of said Board shall be final.

It is further agreed by and between the parties hereto, that should the party of the first part refuse or neglect to prosecute the work herein contracted for, with the requisite vigor to insure its completion within the time herein stipulated, or in any other respect make any substantial

violation of this agreement, the said Board shall have power to annul this agreement and to contract anew with other parties without prejudice to the claim of said party of the second part for damages arising from breach hereof.

The party of the second part further covenants and agrees with the party of the first part to build a bulkhead on the northerly and easterly boundaries of said areas to be filled, and also on the line between said areas and the area to be filled by Thomas Potter under his contract with the said Commonwealth dated Aug. 28, 1880.

In testimony whereof the said New England Dredging Company has caused its corporate seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by Charles H. Souther, its president and treasurer; and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by its Board of Harbor and Land Commissioners, the day and year above written, and the same to be approved by its Governor and Council.

NEW ENGLAND DREDGING COMPANY,

[NEW ENGLAND DREDG-
ING COMPANY SEAL,
1873.]

BY CHARLES H. SOUTHER,
Prest. & Treas.

Executed in presence of
D. KOPFMANN.

COMMONWEALTH OF MASSACHUSETTS,

[SEAL OF THE COMMON-
WEALTH OF MASSA-
CHUSETTS.]

BY ALBERT MASON,
FRANCIS A. NYE,
HENRY L. WHITING,
Harbor and Land Commissioners.

IN COUNCIL, Aug. 18, 1881.

Approved

HENRY B PEIRCE,
Secretary.

[3.]

Articles of Agreement made this Sixth Day of September, in the Year Eighteen Hundred and Eighty-One, by and between F. G. WHITCOMB of East Boston, in the County of Suffolk and Commonwealth of Massachusetts, Party of the First Part, and the COMMONWEALTH OF MASSACHUSETTS, acting by its Board of Harbor and Land Commissioners, Party of the Second Part, witness :—

The said party of the first part hereby covenants and agrees with said party of the second part, to furnish all the materials for and build about 4,000 feet of bulkhead on South Boston Flats, situated as follows : Beginning at the easterly line of B Street and southerly line of Eastern Avenue, running thence easterly along the southerly line of Eastern Avenue 600 feet, thence turning at right angles and running northerly 1,150 feet, thence turning and running easterly parallel to the exterior line of occupation of South Boston Flats, to a point 100 feet east of the easterly line of D Street extended, thence turning and running southerly parallel to and 100 feet east of the easterly line of D Street, about 2,280 feet, leaving a gap about 400 feet long in the most northerly line, and, if required, a gap in the most easterly line.

The bulkhead is to be built of spruce piles driven six feet apart on centres with two spurshores to each pile, and the piles planked from the surface of the mud to grade 13, and capped above the planks with a double girder cap each 6" $\times$ 12".

The plans in the office of the Harbor and Land Commissioners show the details and method of construction of the bulkhead, and are to be followed in all details not mentioned in this contract.

The piles and spurshores shall be straight and free from large knots, and not less than ten inches in diameter at the butt, and not less than six inches in diameter at the point when ready for driving. They are to be driven ten feet into the hard bottom, and all those injured by driving shall be removed and replaced by sound ones at the expense of the contractor.

The faces of the main piles must be brought to a true line before the planking is put on, the tops are to be cut off and capped at grade 14, and the spurshores are to be fitted one at grade 4, and the other at grade 12, and each one will be bolted with one 1½ inch screw-bolt. The end and corner piles are to be braced by four spurshores, instead of two, placed and fitted as directed by the engineer.

The caps are to be spruce, 6" $\times$ 12", and as long as possible, none being less than fifteen feet, and shall be fitted as shown on the plan bolted to the piles with one-inch screw-bolts, and the splices bolted with ¾ inch screw-bolts.

The planks are to be spruce, three inches thick, and in as long lengths as possible, none being less than twelve feet long, and the butt-joints must come on the piles. They are to be spiked to the piles with $\frac{3}{4}$ inch square wrought-iron ship-spikes six inches long.

On the northerly and easterly lines the planking shall be still further secured by strips of spruce plank three inches by six inches well driven into the mud, and reaching to the top of the planking, and bolted through to the main piles by three $\frac{3}{4}$ inch screw-bolts.

All the timber to be sound, sawed square, and free from large knots.

All the work to be done in a neat and workmanlike manner, in accordance with the lines graded and instructions given by the engineer, and to the satisfaction of the commissioners and the engineer.

The work is to be commenced within a reasonable time, and prosecuted continuously in all suitable weather, till its completion.

The said party of the second part hereby covenants and agrees with said party of the first part to pay said party of the first part for said bulkhead at the rate of \$3.59 per lineal foot, and for said extra fastening to pay at the rate of \$1.65 for each six lineal feet of bulkhead when said extra fastening is put on.

Monthly estimates of the work done will be made by the engineer, and payment of ninety per cent of the contract-price will be made thereon, the remaining ten per cent to be retained until the completion, final measurement, and acceptance of the work.

It is agreed by and between the parties hereto, that upon all questions of measurement, lines, or grades, the decision of the engineer of said Board shall be final.

In testimony whereof the said F. G. Whitcomb has hereunto set his hand and seal, and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by its Board of Harbor and Land Commissioners, the day and year above written, and the same to be approved by its Governor and Council.

F. G. WHITCOMB. [SEAL.]

THE COMMONWEALTH OF MASSACHUSETTS,

By ALBERT MASON,

[SEAL OF THE
COMMONWEALTH]

FRANCIS A. NYE,

HENRY L. WHITING,

Harbor and Land Commissioners.

IN COUNCIL, Sept. 20, 1881.

Approved.

HENRY B. PEIRCE, *Secretary.*

Recorded in vol. 2, Treaties, Contracts, etc., pp. 250-253.







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Form 410



